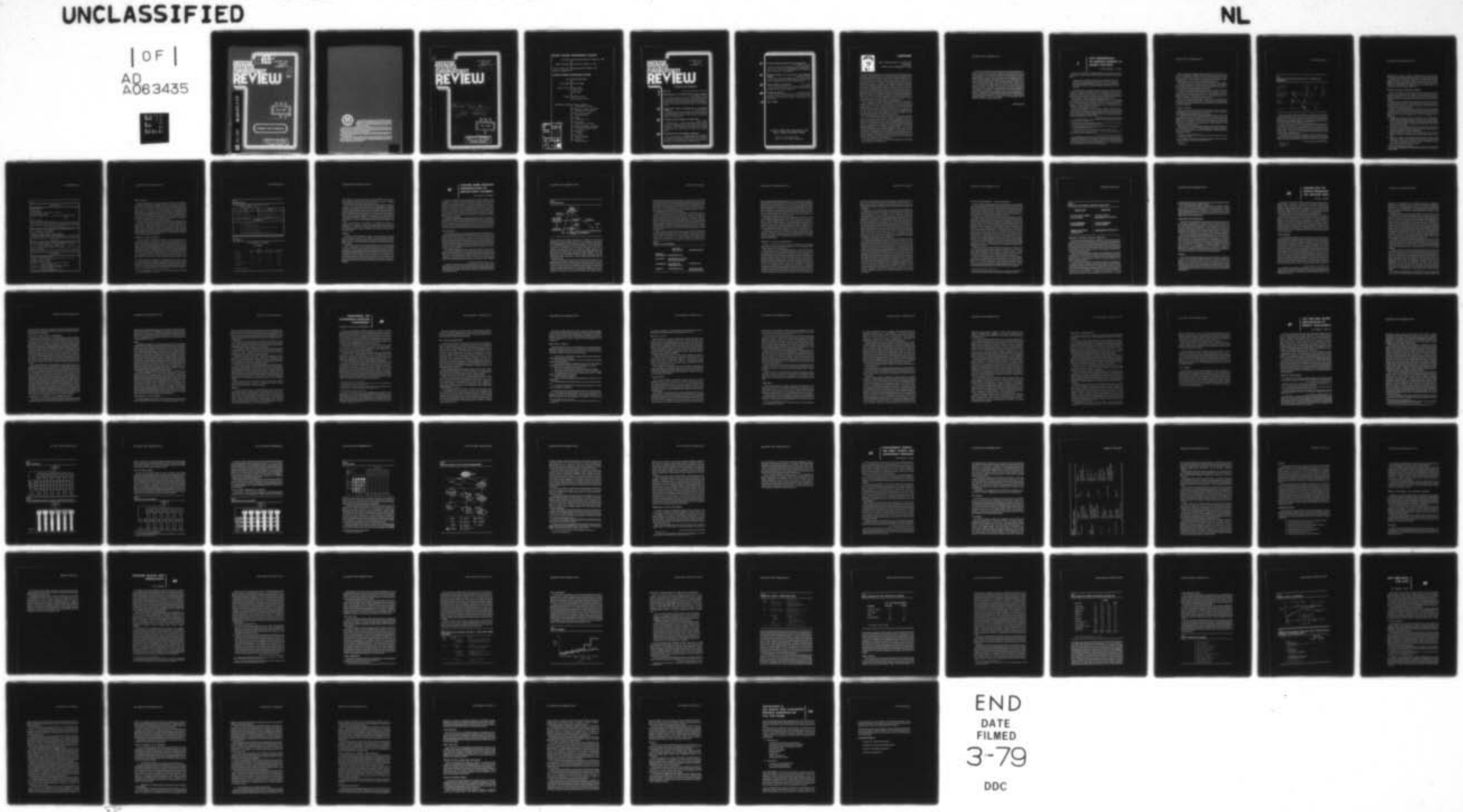
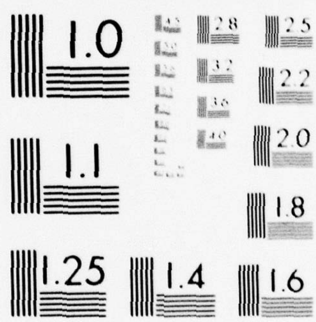
AD-A063 435 DEFENSE SYSTEMS MANAGEMENT COLL FORT BELVOIR VA F/G 15/5
DEFENSE SYSTEMS MANAGEMENT REVIEW, VOLUME I. NUMBERS 7-8. AUTUM--ETC(U)
1978 R W MOORE

UNCLASSIFIED NL

| OF |
AD
A063435



END
DATE
FILMED
3-79
DDC



MICROCOPY RESOLUTION TEST CHART

LEVEL II

DEFENSE SYSTEMS MANAGEMENT REVIEW

AUTUMN 1978
VOLUME I
NUMBERS 7–8

①

DDC FILE COPY

AD A063435

Contracts and Contractors

The Defense Systems Management *Review* is published quarterly by the Defense Systems Management College, Fort Belvoir, Va. 22060, and is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

Statements of fact or opinion appearing in the *Review* are solely those of the authors and are not necessarily endorsed by the Department of Defense or the Defense Systems Management College. Unless copyrighted, articles may be reprinted. When reprinting, please credit the author and the DSM *Review*, and forward two copies of the reprinted material to the Editor.

Submission of manuscripts and other correspondence is encouraged and should be addressed to the Editor. Inquiries concerning proposed articles or distribution may be made by phone at (703) 664–5082 or AUTOVON 354–5082.

The DSM *Review* is available in microfiche or paper copy from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22151, and the Defense Documentation Center, Cameron Station, Alexandria, Va. 22314. When ordering from the Defense Documentation Center, specify the volume, number, and date of the *Review* desired.

6

DEFENSE SYSTEMS MANAGEMENT REVIEW

AUTUMN 1978
VOLUME I
NUMBERS 7-8

Autume 1978

10 Robert Wayne Moore

11 1978 12 75 p.

Vol I num 6
AD61 287
AD50 752

410 036

DEFENSE SYSTEMS MANAGEMENT COLLEGE

Commandant	Rear Admiral Rowland G. Freeman III, USN
Deputy Commandant	Colonel John B. Hanby, Jr., USA
Director, Department of Research and Publications	Captain Ronald M. McDivitt, USN

DEFENSE SYSTEMS MANAGEMENT REVIEW

Editor	Robert Wayne Moore
Assistant Editor	John A. Waring
Editorial Assistants	Susan Pollock Jeanette Tippie Janet Mills
Graphics	Richard B. Brown SP5 Nicholas W. Kunz

DEFENSE SYSTEMS MANAGEMENT REVIEW

AUTUMN 1978
VOLUME I
NUMBERS 7–8

Contracts and Contractors

TENTATIVE THEMES FOR FUTURE ISSUES OF THE *DEFENSE SYSTEMS MANAGEMENT REVIEW*

Winter 1979—Technology Transfer
Spring 1979—Joint Program Management

FOREWORD

Rear Admiral Rowland G. Freeman III
Commandant,
Defense Systems Management College

Much of this issue of the *Review* is focused on the contract and the contractor, which makes it appropriate that I say a few words about the contracting phase of the acquisition process. It has not been uncommon for the acquisition manager to blame the contracting effort for failures in the acquisition process. Various types of contracts have been written for the several phases of the acquisition process—cost-plus-fixed-fee contracts for production; total package procurement; fixed-price research and development contracts; incentive contracts for research, development and production; redeterminable-downward-only contracts; letter contracts; and on and on, each one intended to prevent acquisition shortcomings. The list of ways we have tried to use the contracting process to overcome a lack of good specifications, poor definition of tasks, overoptimistic schedules, and poor program estimation is a lengthy one. However, at the Hershey conference on acquisition research held 31 May-2 June 1978, there was general agreement that we must examine the basics of our acquisition process and make changes there rather than attempt to correct deficiencies in the process through the use of contractual gimmicks.

Early communication between managers and technical and contracting personnel must be established to promote understanding by all parties. The spectrum of actions required for successful contracting necessitates a sound understanding and amalgamation not only of the technical requirements but also of the business and contractual actions required to consummate a good contract. A sound contract, or the "right" type of contract, is the instrument to promote understanding between the buyer (government) and the seller (industry), but it cannot compensate for inadequate planning and execution by the entire government team.

If the contracting phase of the acquisition process is in need of more research and study, it is only one of many aspects of acquisition management that deserve attention. Some examples of major areas of research needing emphasis are phase zero activities in the acquisition policy cycle; tools for meaningful delineation of the range of life cycle costs; quantitative measurement techniques for acquisition management trade-offs; competition in the acquisition cycle; the relationship of the Program Planning Budget System and the Defense Acquisition Review Council process; commercial standards versus government specifications; and the impact of NATO rationalization, standardization and interoperability on the acquisition process; to mention only a few. DSMC will chair with the Federal Acquisition Institute the next Acquisition Research Symposium, to be held at the Naval War College in May 1979. We are looking forward to addressing many of the above issues, as well as those which may be contributed by readers of the *Review*.

Only through sound research can we develop meaningful and useful acquisition policy for the future. Let us hear from you.

With this issue, the Defense Systems Management Review *begins publication in a totally new format. We recognize that a change of this magnitude carries with it an element of risk, and it was not without a great deal of forethought that the changes were undertaken. It is our feeling, however, that this format change was the next logical step in the continuing evolution of the* Defense Systems Management Review. *From its inception, the* Review *has been looked upon as a professional journal—a forum for the exchange of ideas in defense systems management. While from all accounts the* Review *has achieved success in that regard, we are constantly striving to do the job better. The changes reflected in this issue represent the latest but certainly not the last of our efforts in that direction. Nor has outward appearance been the sole focus of our attention. Notwithstanding the McLuhan apothegm that "The medium is the message," a publication rises or falls on the strength of its contents. For that reason, we are continuing to search for and publish papers that we think not only add to the body of knowledge in defense acquisition management, but also provide information applicable in the day-to-day activities of the professional acquisition manager. This is our most difficult, if our most important, task. As always, we invite your comments and criticisms.*

The Editorial Staff

7 PAST PERFORMANCE: AN ESSENTIAL ELEMENT IN SOURCE SELECTION

Colonel Michael A. Nassr

The concept of rewarding or penalizing defense contractors based on their past performance is certainly not new. Hitch and McKean identified its importance in 1960:

> ...Nothing spurs a contractor as effectively as knowledge that his performance will be compared directly with that of a rival or rivals, with appropriate rewards and penalties—either in the short run (by the terms of the current contract) or the somewhat longer run (in the next or later contracts).[1]

Frederick M. Scherer thoroughly explored the concept of competition based on contractor reputation and identified numerous difficulties with such a system, including the problem of time, quality, and cost weighting; the difficulty of measurement without the influence of biases; and the problem of blending good and poor jobs together to obtain an overall index of contractor performance.[2]

Today's Defense Acquisition Regulation (DAR) states that "....the Contracting Officer shall consider not only technical competence, but also all other pertinent factors including management capabilities, cost controls, and past performance in adhering to contract requirements, weighing each factor in accordance with the requirements of the particular procurement...."[3]

The Air Force regulation on source selection outlines a separate section on "Offerors' Past Performance" as part of the Source Selection Advisory Council Analysis Report;[4] and the former weighted guidelines method of the Armed Services Procurement Regulation (ASPR) included a factor for contractors' past performance in computing the profit or fee objective.[5]

---

[1] C. J. Hitch and R. N. McKeon, *Economics of Defense in the Nuclear Age* (Santa Monica, Calif.: The Rand Corporation, March 1960), pp. 232–233.

[2] Frederick M. Scherer, *The Weapons Acquisition Process: Economic Incentives (Vol. II)* (Boston: Harvard Business School, Division of Research, 1964), pp. 68–101.

[3] Department of Defense, *Armed Services Procurement Regulation*, 1976 Edition (Washington, D.C.: U.S. Government Printing Office), pp. 1–903.1 (iii).

[4] Air Force Regulation 70–15, *Source Selection Policy and Procedures*, 16 April 1976, p. A-4.

[5] P. Kayafas, *Contractor Past Performance: Basis for Contract Award*, Professional Study No. 3940 (Maxwell AFB, Ala.: Air War College, April 1970), p. 23.

Colonel Michael A. Nassr is Director of Procurement, Control and Communications Systems, at Air Force Systems Command's Electronic Systems Division. Previous assignments include duties as Director of Manufacturing, Headquarters Air Force Systems Command; Director of Systems Engineering, Aeronautical Systems Division; and Engine Program Manager in the Air Launched Cruise Missile Program Office. Col. Nassr holds a B.S. in general engineering from the U.S. Naval Academy and an M.B.A. in R&D management from the University of Southern California.

Despite this apparent recognition of the importance of a contractor's "track record," the Department of Defense (DOD) currently displays scant evidence of placing meaningful emphasis in this area. It is not uncommon to find a case in which a company receives a very desirable new program award even though that company's performance on an earlier contract was essentially unsatisfactory.

This situation is in stark contrast to that of the private sector, where organizations generally maintain a list of preferred vendors and suppliers. The "preferred list" is primarily determined by experience from previous contracts and frequently is the major influence in the determination of future awards.[6]

Competition in the defense marketplace is such that contractors give top priority to moving into promising new fields, thereby promoting capabilities for winning future programs. Achieving good performance on current programs becomes of secondary importance. Unfortunately, there is no well-defined program in the Department of Defense to effectively counter this situation.

Thus, today's source selection authority (SSA) is missing an important and powerful tool for making the selection decision. Although he may be presented with some subjective and sketchy information on past performance, it is generally lacking in depth and consistency.

Lessons of the Past

What can be done to rescue the source selection authority from this dearth of meaningful past performance data? Since the problem is not a new one, there is ample information from the past which bears examination.

In the 1960s the Department of Defense developed considerable experience with its Contractor Performance Evaluation (CPE) system. The system encompassed R&D of $2 million per year or $10 million overall, and production programs of $10 million per year or $20 million overall.[7] The CPE system required that a total of eight DOD forms be completed on a semiannual basis by project managers, service evaluation groups, and contractors.[8]

There was an extensive submission and review process for these forms (Figure 1) prior to their being forwarded to the DOD Data Bank at the Defense Documentation Center for future use by source selection organizations, contracting officers and the renegotiation board.[9]

---

[6]J. Ronald Fox, *Arming America* (Boston: Graduate School of Business Administration, Harvard University, 1974), pp. 303–304.

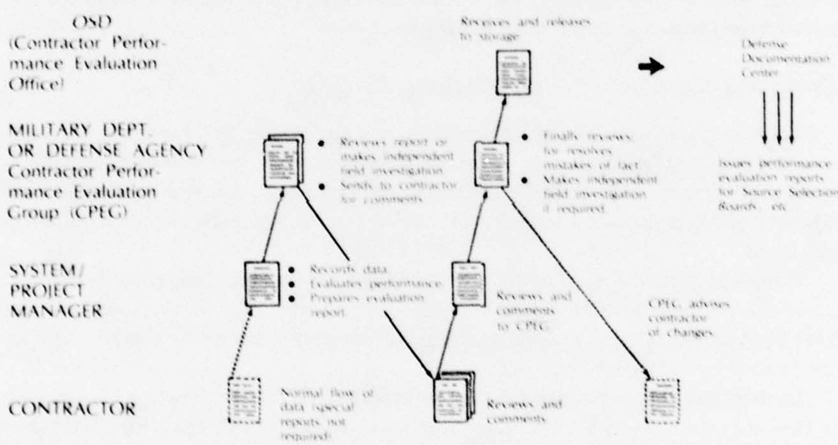
[7]Air Force Institute of Technology, *Selected Readings, Procurement Refresher Course* (Wright-Patterson AFB, Ohio: School of Systems and Logistics, 1970), pp. VI-4.

[8]*Ibid*, pp. 18–43.

[9]*Ibid*, pp. VI-4–9.

Figure 1

FORMER DOD SYSTEM FOR EVALUATION OF A CONTRACTOR'S PERFORMANCE



When it was initiated in 1963, the CPE program was designed to be fact-oriented to the maximum extent possible. There were provisions, however, for subjective comments by both the project manager and the contractor. This aspect of the program allowed it to degenerate into a series of verbal duels between project offices and contractors whenever honest differences of opinion arose.[10]

A survey conducted in 1967 by the Air Force Systems Command (AFSC) found that CPE data was being used in varying degrees by source selection advisory councils, but there was only one instance where it proved to be a decisive factor in contract award.[11] Thus, there was no firm evidence that the program was achieving its prime objective despite years of operation and extensive involvement of both government and contractor personnel.

In November of 1970 the program was formally cancelled for being neither cost effective nor useful for source selection. Although the sophistication and the volume of paper that it generated helped lead to its demise, a prime cause of the program's

[10]Kayafas, pp. 34–35.

[11]*Ibid.*, pp. 37–38.

termination was its failure to employ a methodology that would allow source selection authorities and contracting officers to consistently apply the available data.

Experience from the CPE of the 1960s points to the fact that a successful program of the future must emphasize simplicity and the prime elements of cost, schedule and technical performance. Subjective narrative assessments should be avoided and a methodology for utilization must be developed, enforced, and continuously tracked to determine its effectiveness.

Proposed Contractor Performance Program

There is still a need for a structured program to measure and take into account a contractor's past performance. Few dispute that past performance should be considered somewhere in the source selection process. Diverse opinions exist, however, as to the type of information required and the manner in which it should be employed.

Proposed herein is a simplified, fact-oriented data system that records the cost, schedule and performance status of major Department of Defense contracts that have been active in recent years. Included is a suggestion on how this information can be used by source selection activities.[12]

Initially it is recommended that the information be accumulated on Department of Defense contracts over $5 million which are currently active or which have been completed during the past three years. The data generated would be concise and broken into four areas: (1) administrative, (2) cost, (3) schedule, and (4) performance:

- *Administrative.* A listing of the contract number; dollar value; procuring agency; acquisition phase (advanced development, production, etc.); a brief description of work; names and telephone numbers of the government project manager, procuring contracting officer, and administrative contracting officer; dates of contract; and type of contract.
- *Cost.* Percent over or under target and dollar amount (actual for completed, and estimated at completion for active contracts); number and dollar amounts of claims submitted and claims approved/disapproved.
- *Schedule.* Months the contract has been delinquent/total contract months; reasons for delinquencies; changes made to original schedule and reasons for them.
- *Performance.* Number of DD 250 (Material Inspection and Receiving Report) acceptances; numbers of major deficiencies and conditional acceptances on DD 250s; numbers of deviations and waivers; numbers of specifications and test plans/reports resubmitted for approval. (Figure 2)

---

[12]M. L. Fowler, Assistant Deputy for Procurement, Electronic Systems Division, Air Force Systems Command, designed the original data base from which the proposed contractor past performance system has been developed.

Figure 2

ADMINISTRATIVE
Contract Number: Dollar Value: Procuring Agency: Acquisition Phase: (Development or Production) Brief Description of Work: Name and Telephone No. of: Government Program/Project Manager: PCO: ACO: Dates of Contract: Type of Contract (e.g. FFP, CPIF, etc.):

COST (FOR CPIF, CPFF, FPIF, FPIS)
PER CENT over or under target (actual for completed contracts and MEAC for active contracts): Dollar Amount over or under target: Number and Dollar Amounts of claims submitted: Number and Dollar Amounts of claims disapproved:

SCHEDULE
Number of months contract was/has been delinquent and reason(s): Per cent of months contract was in delinquent status (i.e. total months delinquent divided by total contract months): Number of times original schedule has been changed, by how much, and reasons for change:

PERFORMANCE
Number of DD 250 Acceptances: Number of Major Deficiencies/Conditional Acceptances on DD 250's: Number of Deviations Granted: Number of Waivers Granted: Number of Test Plans and Reports Submitted for Approval: Number Submitted Late: Number of Test Plans and Reports Resubmitted for Approval: Number of Specifications Submitted for Approval: Number Submitted Late: Number of Specifications Resubmitted for Approval:

Data Collection

The proposed information can be gathered in a number of ways. Until a DOD-wide system or requirement is established, requests for proposals may be used to solicit the desired information from offerors. This data could then be validated in pre-award surveys. The mere fact that such information is being requested from offerors will serve to put them on notice that the Department of Defense is giving added emphasis to contractors' past performance. This type of information could also be maintained by DOD administrative contracting officers, who would update it as required in order to submit it to procuring agencies in conjunction with contractor proposals. It is important that the contractor's most recent experience be included, as recently ruled by the General Accounting Office (GAO).[11]

Air Force Systems Command already has a computerized procurement information program, the Automated Management Information System (AMIS), which could possibly be tapped to add the above data on contractor performance. An addition to the current AMIS could be made so that the information would be continuously and immediately available to all organizations in AFSC. Since the Defense Logistics Agency will be exchanging procurement information with AMIS, needed information could be included on all contracts administered by the Defense Contract Administration Service (DCAS).

Utilization in Source Selection

The method and form in which this information is used can be standardized to a simple, basic report for presentation to source selection authorities. The cost information would reflect the number of contracts which met or were over or under target costs. Schedule information would reflect total months of original contracts and the number of months delinquent and/or of schedule extension. The technical performance portion would reflect the quality of the products delivered by indicating the number of deviations, conditional acceptances, etc., on a percentage basis relative to the total items delivered. Dollar values would be totaled to show gross overrun/underrun for the total contracts charted. Examples of summary charts which might be developed for source selection purposes are shown in Figures 3 and 4.

Since standardized incorporation of such information in the source selection process will constitute a new emphasis on past performance, requests for proposals must clearly state the manner in which past performance will be considered as part of the criteria for contract award. Air Force Systems Command is currently conducting a test in which past performance is being utilized as both a major ranked or

[11] *Federal Contract Reporter*, No. 726, April 19, 1978 (GAO: New Hampshire-Vermont Health Service, 57 Comp Gen, B-189603, 3/15/78), p. A-7.

Figure 3

CONTRACTOR XYZ

NO. OF DEVELOPMENT CONTRACTS: 12 (7 COMPLETE, 5 ACTIVE)
TOTAL DOLLAR VALUE: $213M

COST	SCHEDULE
CONTRACTS OVER TARGET: 10 CONTRACTS UNDER TARGET: 2 GROSS PER CENT OVER/UNDER TARGET COSTS: 8% (17M) OVER	TOTAL CONTRACT MONTHS: 210 MONTHS CONTRACTS DELINQUENT: 19 (9%) MONTHS OF SCHEDULE CHANGE DUE TO NONPERFORMANCE: 22

PERFORMANCE
NO. OF DELIVERABLE ITEMS: 93 NO. OF DEVIATIONS AND WAIVERS: 34 NO. OF MAJOR DEFICIENCIES ON ORIGINAL ACCEPTANCE INSPECTIONS: 7 NO. OF CONDITIONAL ACCEPTANCES: 14 TEST PLANS/SPECIFICATIONS SUBMITTED LATE: 25/300 = 8.3% TEST PLANS/SPECIFICATIONS DISAPPROVED: 33/300 = 11%

Figure 4

ABC COMPANY

COST PERFORMANCE (IN MILLIONS)

DEVELOPMENT

PROGRAM	TARGET COST	ACTUAL/ ESTIMATE AT COMPLETION	OVER/(UNDER) TARGET COST	OVER/(UNDER) PERCENT
A-1 RADAR	70	81	11	15.7%
*B-2 MISSILE	32	48	16	50%
C-3 POD	30	40	10	33%
D-4 NAVIGATION SYS.	12.6	11.9	(0.7)	(5.6%)
*E-5 JAMMER	7.2	7.8	0.6	8.3%

*COMPLETED PROGRAMS

scored area and as a general consideration for award. Offerors will be invited to select examples of past performance which illustrate the contractor's capability regarding the specific evaluation criteria of the solicitation.

In the event a contractor has not performed on previous Department of Defense contracts, it can be stated that information relative to performance on comparable non-DOD contracts may be requested. In any event, it should neither be implied nor intended that data contained in any computerized data bank will constitute the sum total of all past performance information to be considered by the source selection authority. Other pertinent factual information, such as that which might be gathered from contact with program managers or contracting personnel, can and should be made available for the SSA's consideration. If additional information is gathered on one prospective contractor, then comparable information should be gathered on all others.

Since the prime objective of the program is to influence source selection, a feedback system is required to continuously evaluate whether past performance information is actually playing a role in source selection decisions. A survey form to be completed by source selection authorities and/or PCOs could provide the information desired.

Summary

The purpose of source selection is to select a contractor, not merely to choose between competing proposals. Yet the emphasis in most Department of Defense source selections is overwhelmingly upon the evaluation of technical proposals. The difference between contractors is seldom so illuminated as the differences between their proposals.

A practical reporting system on contractors' past performance is urgently needed in order to consider past as well as proposed performance when selecting DOD contractors. A system is proposed which will provide factual data to source selection groups while not requiring the generation of complicated or sophisticated information which might require expenditure of inordinate manhours. At a later date it may be desirable to develop performance indices in each of the three areas of cost, schedule and performance. With a positive determination by top management and with an open mind by those who must implement such a program, we can take a giant step towards improving the relationship between past performance and future awards.

15

TOWARD MORE EFFECTIVE IMPLEMENTATION OF SPECIFICATION TAILORING

Dr. Warren E. Mathews

One of the more frequently discussed techniques for improving defense systems management is "tailoring," or the selective application of military specifications and standards to an individual program. The purpose of this paper is to present some thoughts on what it takes to make effective tailoring actually happen in the everyday, real world. The observations and conclusions presented here are based on a broad collection of responses from senior representatives of the American Defense Preparedness Association, the Aerospace Industries Association, the Electronic Industries Association and the National Security Industrial Association. It should be made clear, however, that these observations do not necessarily represent the official positions of those associations.

I will begin by identifying the principal participants in the military specification (MIL-SPEC) and military standard (MIL-STD) tailoring business and examining their respective roles. I then will assess the key influences on those participants and offer some observations and recommendations as to how they can be motivated toward more effective implementation of tailoring. Finally, I will offer an organizational recommendation for facilitating effective tailoring within the military services.

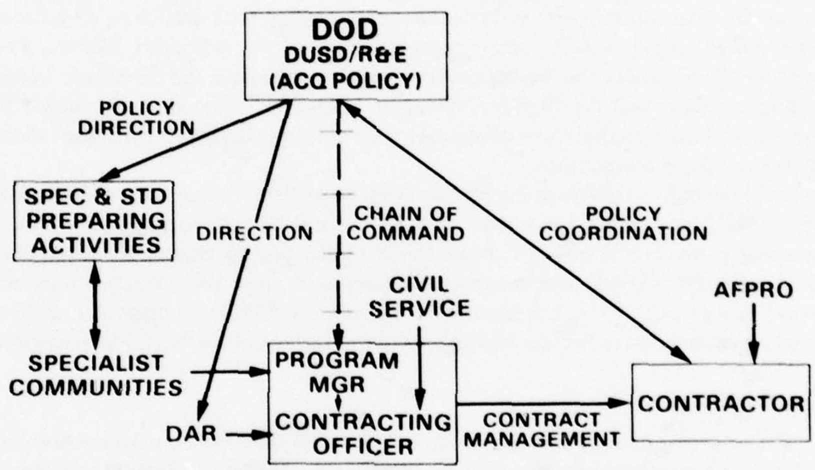
The Participants

The principal participants in the tailoring business and the communication and authority relationships between them are illustrated in Figure 1. Because tailoring is inherently specific to a program, the real center of this activity is necessarily the program office, including the program manager, the contracting officer, and the people who support them. The other major actors are the contractor, through whom the program office accomplishes its mission; the preparing activities and associated specialist communities, through which the specifications and standards come into existence and are maintained and interpreted; and the Department of Defense, overseer of the entire enterprise.

The program manager receives direction through the chain of command extending down to him from DOD. He in turn provides partial direction to the contracting officer, who also has a parallel reporting path through his functional segment of the Civil Service. The specifications and standards of concern here are generated and maintained by preparing activities, which are identified by and receive policy direction from the Defense Materiel Specifications and Standards Office (DMSSO)

Dr. Warren E. Mathews is Director of Product Effectiveness, Hughes Aircraft Company, a position he has held since 1975. He was formerly Assistant Group Executive of Hughes Aircraft Company's Electro-Optical and Data Systems Group. Dr. Mathews received a B.A. in physics and mathematics from Ohio Wesleyan University, a B.S. and M.S. in electrical engineering from Massachusetts Institute of Technology, and a Ph.D. in physics from California Institute of Technology, where he was the recipient of a Howard Hughes Fellowship.

Figure 1
THE PARTICIPANTS



within the Office of the Deputy Undersecretary of Defense for Research and Engineering (Acquisition Policy). This office is also responsible for the Defense Acquisition Regulation (DAR) (previously Armed Service Procurement Regulation, or ASPR), the primary source of directive guidance to the contracting officer in the creation and management of the contract(s). Finally, there is the coterie of specialist communities that advise and support the program manager in the interpretation and application of the many thousands of MIL-SPECs and MIL-STDs, and the Air Force Plant Representative Office (AFPRO), Navy Plant Representative Office (NAVPRO), or other government representative who provides local surveillance at the contractor's plant in support of the program office and the procuring service.

Relative to tailoring, the program office can receive direction or guidance via the program manager's chain of command and the somewhat independent channel of DAR/ASPR, and assistance from the specialist communities. Since the preparing activities are in almost all cases an integral part of the specialist communities, and since the program manager usually is not personally experienced in the many specialities involved, the channel to him through the specialist communities frequently serves effectively as a third directive channel, even though an official

organizational description would not recognize it as such. Also of interest is the closely coupled interaction the contractors have, through the industry associations, with the generation and revision of both DOD policies and individual specifications and standards. The actual application of the specifications and standards is exclusively by way of the contract provisions; however, these provisions are subject to some degree of local interpretation by the service plant representative office or corresponding resident government representative.

In examining the roles of the various participants in the tailoring process, it is important to recognize that there are actually two categories of tailoring. The category that has gotten most of the attention in a flurry of directives, handbooks, and white papers is the conscious selective application of specifications and standards, or of segments thereof, to individual programs. But there is another important category of tailoring that generally has not been recognized as such, but which has been implemented, consciously or otherwise, almost universally. This is the *interpretation* of the general equipment and management discipline specifications as applied by the individual contractors in the various military product areas (ships, aircraft, electronics, etc.).

Figure 2 shows the principal roles of the previously identified participants in these two categories of tailoring. In the selective application category, the focal point is the military program office, which can encourage or block tailoring by its receptiveness or non-receptiveness to tailored proposals and pertinent contract changes. The program office also can actually accomplish some tailoring, particu-

Figure 2
ROLES OF THE PARTICIPANTS

	SELECTIVE APPLICATION	INTERPRETATION
REQUEST ENCOURAGE	PROGRAM OFFICE	
FACILITATE	PREPARING ACTIVITIES SPECIALIST GROUPS	
ACCOMPLISH	CONTRACTOR PROGRAM OFFICE	CONTRACTOR
APPROVE	PROGRAM OFFICE	AFPRO, NAVPRO PROGRAM OFFICE

larly of the management discipline specifications, prior to issuance of the request for proposal (RFP). An unavoidable reality, however, is that the bulk of actual tailoring work *must* be done by the contractor(s), who are the only ones who have both the experienced people and the integral involvement with the design effort necessary for effective tailoring. The only other possible performers of tailoring, the military specialist communities, are naturally somewhat parochially motivated not to eliminate or diminish the detailed provisions that are the heart of their reason for existence in the first place. Also, they have no direct involvement with the cost pressures which are the primary reason for tailoring.

The tangible results of tailoring, of course, are changes to the contract or other formal documents defining the program effort. Thus the output of the contractor's effort is typically a proposal, which it is up to the program office to approve or otherwise dispose of. The specification and standard preparing activities and the remainder of the specialist communities, although inherently ill-adapted to the actual accomplishment of tailoring, nonetheless can play an important role in structuring the specifications and standards in such a way as to facilitate tailoring.

With respect to the interpretive category of tailoring, assuming that no actual substantive change in the intent of the document is desired, the principal players usually are the contractor and his local customer surveillance office. The program office may be called upon to ratify significant agreements, however, or to referee significant disagreements.

Influences on the Central Participants

Now let's look a little more closely at some of the influences on the program office and the contractor that play an important role in determining whether effective tailoring can or cannot take place.

Major influences on the program manager pertinent to tailoring include directives coming down his chain of command, his dependence on the various specialist communities, particularly with regard to disciplines in which he has little or no personal background, and the political and other career risks that are inherent in the position of program manager. Now, the kind of directives he may get relative to tailoring, ranging from a simple "Do it," to directives prescribing in detail how he should do it and how he should document the results, are likely to appear to him as constraints, or hurdles to be cleared, i.e., one more set of problems to contend with, on top of the horrendous stack he already has. Unfortunately, the specialist communities on which the program manager must depend may seem to contribute to the problem rather than to the solution, because of their own natural motivations not to tailor out any of the provisions that seem so important to them. Finally, as a built-in career risk that goes with the job, there is the ever-present possibility of high-level

criticism for some alleged failure of the program manager to adequately promote or protect the interests of the government in his dealings with the contractor. The almost certain net result is some degree of reluctance to depart from the safety and convenience of full-whammy application of all the officially approved specifications and standards.

Turning now to the contracting officer, pertinent major influences on him are his semi-autonomy from the program manager, the legal authority of DAR/ASPR, and a deeply ingrained concept of "consideration." The independence provided the contracting officer by his warrant serves to insulate his contracting and financial responsibilities from the totality of overall program goals. On the other hand, he is unequivocally committed to the legally binding DAR/ASPR, which has been inherently conservative because of the nature of the committee which until recently has been responsible for its care and feeding. And at an even more fundamental level, the contracting officer has been trained from the beginning to regard contracting as an adversary proceeding in which concessions should be made only if there is an equally valuable *quid pro quo*. Thus, elimination of any contractual requirement by tailoring, regardless of the actual utility of that requirement, would automatically appear to him (and his functional superiors) to call for "consideration" from the contractor. The result of these various influences is a deep-seated bias against permitting the contractor to benefit by tailoring actions, particularly any that might be interpreted as "letting the contractor off the hook."

Reluctance about tailoring on the part of the program manager, plus orientation of the contracting officer against permitting the contractor to benefit thereby, will tend to produce strong anti-tailoring motivation on the part of the contractor as well. Although industry inherently favors tailoring because of the greater flexibility and efficiency it promises, the most fundamental objective is to stay in business and make a profit. That requires, first of all, winning competitions, and *that* generally means offering most nearly what the program office really wants. If, as usual, the RFP calls out a collection of MIL-SPECs and MIL-STDs, most proposals will advertise full compliance therewith rather than risk being rejected as nonresponsive. Even if the RFP explicitly encourages tailoring, the proposals will still feature full compliance to the significant specifications if the competitors sense that this is what the program office really wants. After all, protests seldom win competitions. And even after the contract is awarded, there will be little contractor enthusiasm for tailoring if he is not permitted to share in the savings that result. Another channel of customer influence is the local government surveillance agency (AFPRO, NAVPRO, etc.). This influence tends also to be anti-tailoring to the extent that it seeks, via the Air Force's Contractor Management System Evaluation Program or similar means, to judge contractor management adequacy and compliance independently of contractual requirements.

The Key Recommendation: Accurate Perception

Analysis of the preceding discussion of anti-tailoring influences reveals that they stem overwhelmingly from the perception that tailoring means giving up something; that it means retreating from what we really would like to have because we decide that that last increment of goodness isn't worth what it costs. Reflecting the views of a broad segment of industry, however, I suggest that this perception is *wrong;* that what we usually are seeking via tailoring, just as in the case of value engineering, is a product better suited to its application, *not* an inferior product.

In Figure 3 we see this point pursued further. The left-hand column contains phrases that I believe characterize the most commonly held perception of tailoring, particularly as applied to general design and product discipline specifications. The opposite column, on the other hand, contains the corresponding phrases that I think accurately characterize what most meaningful tailoring actually is all about. The first phrase in that column lies at the very heart of the issue. For the majority of the potential cost driver specifications and standards identified in the Shea Panel report,* indiscriminate full application to a real program would not be ideal but would in fact be excessive and, in some cases, positively undesirable. The goal of tailoring is therefore properly perceived not as invocation of the minimum tolerable selection from a set of requirements, all of which are desirable, but rather invocation of the *pertinent* or *optimum* requirements from a set, some of which are and some of which are not meaningfully applicable to the particular program. Correspondingly, the contractor actions desired should be viewed not in the negative light of seeking deviations and waivers to already invoked (and therefore presumably desirable) specifications, but rather in the positive light of recommending the optimization of the specification structure.

Perhaps a more incisive way of putting the above thoughts is to emphasize that we are not urging the program offices to acquire marginal systems, nor to function with marginal management controls. Rather, we are asking that they acquire systems that are *optimum* for their applications, avoiding in the process requirements that are inappropriate, excessive, or perhaps actually counterproductive.

This point is of crucial importance, because the numerous, strong anti-tailoring influences on the program manager and contracting officer are very largely eliminated by acceptance of the positive perception summarized in the right-hand column of Figure 3. It is vigorously urged that a major campaign be mounted to get this contrasting perception recognized and promulgated throughout the various communities (including the Congress) that are involved in defense materiel acquisition.

---

*Defense Science Board Report, *Report of the Task Force on Specifications and Standards*, Dr. Joseph F. Shea, Chairman. Office of the Director, Defense Research and Engineering, April 1977.

Figure 3
PERCEPTIONS OF TAILORING: BARRIERS OR MOTIVATORS

TENDS TO BE	SHOULD BE
THE FULL SPEC IS IDEAL BUT EXPENSIVE	THE FULL SPEC IS EXCESSIVE AND WASTEFUL
INVOKE MINIMUM REQUIREMENTS	INVOKE PERTINENT REQUIREMENTS
PERMIT DEVIATIONS AND WAIVERS	ENCOURAGE OPTIMIZATION

Suggestions Concerning Contractor Motivation

From the earlier analysis of influences, it is possible to develop recommendations for specific actions that the program office can take to stimulate meaningful tailoring inputs on the part of its contractor(s), assuming it understands and accepts the real significance of tailoring as just presented. These suggestions are aimed at eliminating the contractor's fear of penalty, both directly and by clearly demonstrating the program office's positive orientation. They are also intended to provide positive motivation for the desired action.

In RFPs, the fear of being held nonresponsive can be eliminated by not providing a pre-selected list of specifications to which tailoring recommendations could appear nonresponsive. An even more positive signal can be given by indicating that the quality of tailoring recommendations or evidence of tailoring capability will be factors in proposal evaluation.

In contracts, the fear of penalty for tailoring-type changes can be minimized by referring to the desire for specification optimization (positive concept) rather than to the possible consideration of deviations and waivers (negative concept). That fear can be completely eliminated by providing specifically for contractor sharing in the savings (e.g., via the established incentive pattern). The most positive approach to tailoring, of course, is to include it as a specific task in the statement of work. On major system acquisitions, serious consideration should be given to a funded

contract definition phase in which initial tailoring of key general design and product discipline specifications receives significant attention.

The recent DOD Directive 5000.35, *Defense Acquisition Regulatory System,* offers a channel for communicating DOD policies and instructions concerning tailoring directly, promptly, and undilutedly to the program offices. It is recommended that appropriate sections of the DAR be very carefully written to reflect unequivocally the basic perception of tailoring outlined here and to provide for the suggested RFP and contract approaches.

Organizational Recommendation

Finally, we have an organizational recommendation for facilitating a sound focus on and effective implementation of tailoring within the various services. This recommendation stems from the observation that the basic objective of tailoring is to save money while leaving undiminished, or even enhancing, the utility of the product. The fundamental approach is to assess the pertinence of the various existing specifications and standards, and of individual segments thereof, to the particular application under consideration and to make cost/benefit trade-offs as appropriate.

Now, the specialist communities that generate and provide consultation concerning the myriad of MIL-SPECs and MIL-STDs generally are not well adapted to making this kind of trade-off. On the other hand, this approach is precisely that which underlies the well-established disciplines of value engineering and design-to-cost. As a matter of fact, tailoring can be accurately characterized as the application of the value engineering and design-to-cost disciplines to specifications and standards. This leads to a recommendation that the responsibility for promoting, facilitating and overseeing tailoring within each of the services be assigned to a Directorate of Acquisition Cost-Effectiveness, which would also be responsible for value engineering, design to cost, and related cost-effectiveness factors.

Summary

The first recommendation presented here, that of working to develop an accurately positive perception of tailoring throughout the defense acquisition community, is by far the most important. In fact, it is the basis for the successful realization of the specific actions recommended. If this positive perception can be developed (it can), and if the other recommendations are implemented, the technique of tailoring will cease to be discussed as a technique and will take its place alongside value engineering and design-to-cost as routine concepts in the quest for acquisition effectiveness. ‖

23 SURVEILLANCE OF DEFENSE PROGRAMS: THE INDUSTRY ROLE

Irving J. Sandler

The question, "How much government surveillance and how much regulation of defense industry is enough?" is one that must be continually addressed by the Defense Contract Audit Agency (DCAA). Over the years one of the greatest challenges facing the agency has been to determine how best to utilize available resources in fulfilling DCAA audit responsibilities under existing public laws and procurement regulations. This has required DCAA to continually assess its priorities and direct its efforts to those areas believed to carry the highest risk.

Determining the amount of resources which should be devoted to an audit is a problem facing both government and non-government auditors. The problem is made even more complex because of the pressures for increased emphasis on regulatory controls that have come from many quarters, including the press, the legislature, the Securities and Exchange Commission, and introspective examinations within the accounting community itself. One might conclude that this is a problem with little or no solution since on the one hand there is a demand for more surveillance, while on the other there are insufficient resources to carry it out. But there is a solution, and to a large degree it rests with and can be influenced by defense contractors themselves.

Audit Standards

It may be helpful to highlight the auditing standards that form the framework within which DCAA auditors are expected to operate. Essentially, DCAA auditors follow the same basic standards of auditing as specified by the American Institute of Certified Public Accountants (AICPA). The Defense Contract Audit Manual requires that the audit be performed by persons having adequate technical training and proficiency as auditors. They must be independent of influence or control by others and are required to exercise due professional care in performing the audits and preparing the reports. The standards established by the AICPA and DCAA for field work emphasize the need both for planning and supervision of the audits, and a proper evaluation of internal control to determine the degree of reliance that can be placed on a company's accounting system. Beyond these basic standards, however, are the more elaborate standards promulgated by the General Accounting Office (GAO) to which DCAA must also adhere. These standards require the agency to (1) look into the financial and compliance aspects of contractor claims to determine whether financial operations are properly conducted, whether financial reports of an

Irving J. Sandler is Assistant Director, Policy and Plans, Headquarters, Defense Contract Audit Agency. He has held a number of management positions with the Agency since it was established in 1965. Before joining DCAA, he served with the Auditor General, USAF, at the field audit office, district, and headquarters levels. Mr. Sandler is a Certified Public Accountant and holds B.B.A. and M.B.A. degrees from Northeastern University.

audited entity are presented fairly, and whether the entity has complied with applicable laws and regulations; and to (2) look at how the entity is managing or utilizing its resources (personnel, property, space, etc.) This requires that the agency determine causes of any inefficiencies or uneconomical practices, including inadequacies in management information systems, administrative procedures, or organizational structure.

With this very brief overview of auditing standards, let us now concentrate on the audit standard that deals with the degree to which an auditor may rely on a contractor's system of internal control. DCAA prefers that management take the initiative to monitor its own operations to assure efficient and economical performance. Under such circumstances, DCAA involvement can be significantly reduced, and from industry's perspective government surveillance can be reduced. If the agency can place a high degree of reliance on a contractor's system of internal control—that is, if its estimated costs are reasonable, if the organization is efficiently managed, and if the cost accounting system provides for the screening of unallowable expenses and produces equitable allocations—then the risks to the government are considerably lessened and the scope of DCAA audit reviews can be adjusted. Thus, the answer to the question, "How much surveillance is enough?" depends a great deal on the degree to which industry maintains surveillance of itself. This is the goal that government and industry should be jointly striving to reach.

One of the best internal controls is an internal audit function. Once again, DCAA position on the use of the work of industry's internal auditors is consistent with that of the AICPA. While the work of the contractor's internal auditors is not considered a complete substitute for the DCAA audit, it is taken into consideration by the Agency when determining the nature, timing, and extent of its own auditing procedures.

The mere presence of a contractor internal audit group does not in itself mean that DCAA would rely on the work of that group in determining the scope of its reviews. The agency would first review the contractor's internal audit function to determine its overall mission and responsibilities. The agency is particularly interested in several areas, such as work performed by the internal auditors that could affect planned DCAA audits, the competence of the contractor's staff, and the independence of the internal audit organization. Significant in this regard are qualifications of the contractor's internal audit staff, their training, and their supervision. Additionally, the objectivity of the internal auditors is an important consideration. Their reporting level in the organization should be high enough to permit them to work independently of those responsible for the functions being audited.

As a final point, arrangements must be made with the contractor's internal audit staff for access to their audit programs, working papers, and reports. Hence, if the

contractor's internal auditors are competent and they permit the government to review their work to make sure that their conclusions can be relied upon, government surveillance can be reduced.

Public Law 87–653—Truth in Negotiations

Implementation of Public Law 87–653 by the Department of Defense created a special area of DCAA responsibility for surveillance of defense contractors. This law was enacted in 1962 as a result of GAO reports of overpricings disclosed in the negotiation process. It is important to remember that this law was enacted despite the fact that its provisions were already substantially covered by the Armed Services Procurement Regulation, now called the Defense Acquisition Regulation (DAR). It was because of the reported noncompliance with such existing regulations that Congress deemed it necessary to put the full effect of the law behind pricing requirements. Public Law 87–653 gives the government the right to adjust the contract price when that price is based on inaccurate, incomplete, or noncurrent cost or pricing data. DOD assigned contractor surveillance of this program to DCAA, who carries it out by sampling defense contract awards. Since DCAA began this effort, there has been an overall reduction in the incidence of defective pricing, and the Agency's selection process has been modified to emphasize high-risk pricing actions.

The overall implementation of this program has worked satisfactorily, but it is a remedial approach at best and is fraught with the usual burdensome process of administrative settlement and appeal whenever a case of overpricing is suspected. An obviously more productive use of both contractor and government resources would be to shift emphasis from a remedial to a preventive mode; that is, to have industry build in controls to assure the accuracy, currentness, and completeness of bid proposal submissions at the time the bid proposals are negotiated. The procedure is often relatively simple involving a survey to detect the source of any deficiencies. An example of a common problem in this area involves timing. Current information on the latest material and parts prices, and budgetary information on labor or indirect costing rates may take an inordinate amount of time to flow through the "system" to the contract negotiator. What is considered a reasonable time period to update information varies with the materiality and sensitivity of the item involved. A major item affecting cost may have to be updated on the same day. Control procedures can be revised to correct deficiencies, generally with little interruption or additional cost. Where these controls exist in industry, DCAA and even GAO can reduce surveillance to the point of only making test checks to assure continuing reliability.

Unallowable and Unclaimed Cost Identification System

An area that receives widespread publicity and which continues to plague DOD and defense industry involves such expenses as gratuities, entertainment, etc. These

costs are expressly unallowable and many are not claimed by contractors; however, a problem arises because of the considerable effort required to determine directly associated costs. The answer lies not with more government surveillance, but rather with some type of systematic procedure to be used by contractors in accounting for these costs. The DAR Council recognizes the sensitivity of this problem and is working on guidelines to resolve it.

Fraud

It is difficult for an auditor not to talk about fraud. The Contract Audit Manual outlines DCAA's responsibility for detecting fraud. DCAA auditors are expected to be alert for situations or transactions that may involve fraud. Common examples of such activities include falsification of documents such as time cards or purchase orders; charging of personal expenses to government contracts; submission of claims for services not performed or materials not delivered; intentional mischarging or misallocation of costs; deceit by suppression of the truth; regulatory or statutory violations such as bribery, theft, gratuities, graft, or conflict of interest. The auditor's alertness and tests of procedures and transactions, combined with the operation of the contractor's own internal controls, should reasonably insure that material fraud or other unlawful activity is disclosed. However, there is growing pressure from the Department of Justice for government auditors to give increased attention to potential wrongdoing within the contract environment. The Department has expressed concern that often too little thought is given to the soundness of a company's system of internal control to minimize the potential for fraud.

It should be recognized that the amount of audit required to insure that all fraud is discovered is prohibitive, since it would entail examining every transaction. Therefore, simply from a pragmatic point of view, the Defense Contract Audit Agency must review and rely upon, where possible, the effectiveness of the system of internal control maintained by the contractor. Weaknesses in a contractor's internal control can be an indication of poor management and recordkeeping, or of an intentional coverup for fraud. When such weaknesses are found, surveillance efforts are expanded. Conversely, when a contractor's systems are considered to be adequate and tests show no deficiencies, the level of surveillance can be reduced. Agency experience indicates that defense contractors are willing to listen and many times adopt DCAA recommendations to improve upon their systems of internal control to further minimize the potential for fraud. Because of this environment, DCAA has been able to spend less time pursuing suspected fraud.

Opportunities for Cost Avoidance

It has been emphasized that industry can help itself reduce government surveillance by helping DCAA. This may seem a bit incongruous, because in order to

decrease government surveillance, industry will have to incur some additional costs. However, evidence has shown that good internal controls pay for themselves, often many times over. The most common example would be when adequate controls prevent an instance of fraud. But the potential for even greater payback lies with cost avoidance opportunities made possible by the elimination of inefficient and uneconomical practices.

The Defense Contract Audit Agency has achieved excellent results in recent years in reviewing contractor performance for efficiency and economy of operations. The techniques employed do not differ from those which may be used by industry internal audit organizations in assessing their own operations.

A new regulation, DAR 20–1000, has been developed to monitor contractor costs along these lines. From the vantage point of contract auditors, this program is not new but is rather a compilation of some of the better aspects of previously existing procedures for seeking cost avoidance opportunities.

The effective performance of these reviews requires the cooperation of government audit and technical personnel. Where contractors are willing, these reviews could also be accomplished with the cooperation of contractor technical personnel. Current emphasis is on such areas as production scheduling and control, energy conservation, facilities management, and quality assurance.

One of DCAA's most recent and more significant findings for potential savings is in the area of computer graphics. The most fertile areas for use of this technology are in the design and drafting field. A single audit of a major contractor revealed that as much as $6 million to $7 million could be saved annually if computers rather than manual methods were used in preparing production, tooling, and facilities drawings. Audit of another contractor indicated that expanded use of computer graphics could save between $500 thousand and $1.5 million annually. It has been suggested to DOD that ways be considered to encourage more contractors to use computer graphics.

Because reviews of economy and efficiency continue to reveal areas for substantial payoff, DCAA believes it necessary to continue these audits even though industry sometimes views them as increased surveillance.

Summary

For the most part, the degree to which the Defense Contract Audit Agency audits industry depends on industry itself. A fuller understanding of the contract audit mission, the audit standards adhered to, and the intricacies of certain specific areas of audit concern such as fraud and defective pricing, can lead to improved internal controls by defense industry. The mutual interests of government and industry can often be met though satisfactory internal company controls rather than more government surveillance. To this end, it seems clear that industry can take an active role in answering the question, "How much is enough?" ||

MONITORING THE GOVERNMENT/INDUSTRY "PARTNERSHIP"

28

Lieutenant Colonel W. R. Montgomery

In most cases, negotiations on defense contracts are conducted as adversary proceedings. Once the handshake occurs signifying agreement, however, a "partnership" between the government customer and the private industrialist is cemented. At this point, there often seems to be a tendency to presume that success of the contract is assured because of contract enforceability. This presumption is reinforced by optimistic contractor marketing efforts and by fact-finding discussions with contractor technical and management people as well as by government reviews of the contractor's plans and capabilities prior to award of the contract.

Despite these success indicators, however, every contract carries with it certain risks. These risks—known and unknown—are the concern of contract administration. It follows, then, that alert and knowledgeable contract administration is invaluable in assuring successful contract completion.

The multiplicity of contractors impacting today upon the success and readiness of a system to perform is unprecedented. In 1970 the Comptroller General of the United States issued a report indicating that 50 cents of every DOD prime contract dollar goes to subcontractors.[1] Other estimates suggest as much as 70 cents per dollar.[2] This highlights the importance of contract management monitoring.

A contract is an agreement as to price, schedule, quality, and performance. These are the goals to be attained. The administration of the contract involves an active communication and awareness of progress toward each of these goals. This discussion enumerates and briefly considers some options available to the program management team in contract administration. Particular attention is given to that subset of contract administration most closely related to production surveillance. This paper reflects upon 12 months of personal experience in production surveillance of an average of approximately 1,600 undelivered contractual line items each month manufactured by approximately 250 firms. A set of selected responses, by no means exhaustive, is offered here to assist the program management team.

---

[1]Comptroller General, *Need to Improve Effectiveness of Contractor Procurement System Reviews*, Report B-169434, Washington, DC, 18 August 1970, p. 4.

[2]Kenneth Juvette, *Organizational and Communication Realities in Subcontract Management*, Study Project Report PMC 75-1, Defense Systems Management School, May 1975, p. 1.

Lieutenant Colonel W. R. Montgomery, USAF, is Program Manager/Logistics Officer for F/FB-111 Weapon System Trainers, Ogden Air Logistics Center, Hill AFB, Utah. He has extensive Air Force procurement experience, and in 1971–72 studied industry's approach to procurement and production at the General Electric Aircraft Engine Group, Evandale, Ohio, under Air Force Institute of Technology's Education With Industry Program. Lieutenant Colonel Montgomery is a Certified Professional Contracts Manager and Certified Professional Logistician. He holds a B.A. in social sciences from Southwest Texas State University, an M.B.A. in industrial management from the University of Missouri, and is a graduate of DSMC Program Management Course 76-2.

This discussion presumes, for the sake of brevity, that pre-award procurement activities were properly accomplished. Our concern here is with the indications and alternatives in the post-award phase of procurement. "Now that we're married, how can we live together?" might be the stated question.

The Contractual Relationship

As noted previously, a mutual concern for the success of a contract may lead to a feeling of common purpose or "partnership" between the contract management teams in industry and government. While the government works closely with a contractor during the contract administration phase, this relationship by necessity remains at "arm's length." Two reasons dictate this relationship. First, the government/contractor relationship is normally on a continuum, for old contracts are being completed while new ones are beginning. Consequently, a delicate relationship exists to avoid any appearance of misconduct on the part of the government. Thus a formal business relationship is required, even when a close harmonious working association may exist. Second, when contractor and government enter into a contract, an obligation to contractual fulfillment is incurred. Any failure to meet the terms of the obligation may result in a penalty under the law. The effect then becomes a careful assurance of compliance by each party. Distrust is not implied but mutuality of concern is.

The relationship between the government customer and the private seller is documented by the contract. However, this relationship does not extend beyond the prime contractor to his suppliers, variously known as vendors or subcontractors. Yet the impact of subcontract or vendor firms can make or break the program.

While the government lacks a direct contractual relationship with the vendors, often there is a requirement for government quality assurance inspectors to witness, verify, or inspect the work done. This requirement is commonly made known by a letter delegating specific responsibilities from the prime contract administration activity. For example, an Air Force plant representative office (AFPRO) may delegate inspection tasks to a Defense Contract Administration Service Management Area (DCASMA) or vice versa.

It is through this channel that government-vendor involvement occurs. However, the management of the subcontractor is explicitly the responsibility of the prime contractor, not the government, although the government is available to assist the prime contractor upon request. In special situations, the vendor program manager may receive assistance in a non-directive, consultative manner. In any case, principal contract management emphasis is appropriately with the prime contractor, who is paid implicitly to deliver management expertise in addition to hardware, software, data, and services.

Obviously, the buying office will also need to document its desires regarding contract management with the plant representative. This essential team relationship can help to assure contract success by emphasizing responsibilities in the letter of delegation, and may possibly result in a memorandum of agreement, which assigns contract administration and clarifies complex issues and responsibilities of an ongoing nature.[3]

What Can Go Wrong?

Having designated the needs and responsibilities in the contract administration delegations, one might expect success to be inevitable. Yet in monitoring contract deliveries and progress toward other post-award milestones, we find a recurring set of problems. An effective monitoring system may reveal that:

1. The contractor or vendor did not understand the contractual requirements when his proposal or bid was submitted;
2. The data package was inadequate to convey the requirement, necessitating clarification and causing delay;
3. The complexity surpasses the capabilities of the contractor's skills, requiring reconsideration of the earlier (prior to contract award) make-or-buy decision;
4. Materials are not available when required, or at all;
5. The contract conflicts with prior commitments in contractor's facility;
6. The contractor's plant lacks physical capacity to achieve required deliveries;
7. The financial posture of the contractor impedes timely delivery, perhaps because his suppliers demand cash payment;
8. Production planning is inadequate;
9. Quality assurance is inadequate to produce materials in conformance with specifications;
10. Excusable delays preclude timely delivery (e.g., strikes, floods, tornadoes, etc.);
11. Government furnished material or equipment is delivered late, or incomplete, or is of improper configuration.

The problems cited above are neither mutually exclusive nor collectively exhaustive. Yet, they suggest the difficulties which may arise after the signing of the contract and the often too-brief "honeymoon" which follows. While most of the difficulties outlined may be avoided by effectively accomplishing a pre-award survey

[3]Air Force Systems Command, *Armed Services Procurement Regulation Supplement Section 20 (C 4)*, 10 August 1976.

or in pre-award conferences, too often the problems go undetected until it is time for the contractor to perform by delivering the required items or services.

How Can I Fix It?

What alternatives exist to resolve such situations threatening performance of the contract? At the risk of emphasizing the obvious, it must be said that candid communications in several packages tailored to the circumstance can help. Choices exist. Each option is designed to produce timely delivery of a product with suitable quality for the price agreed upon. Further, each option helps to protect the rights of the government under the terms of the contract. Thus, each action taken should be carefully documented in the official contract file (as well as in the office taking the action if a separate working file is maintained), for today's actions have a habit of becoming involved in tomorrow's problems.

Usually, awareness comes in steps. Trouble can be anticipated if the symptoms are recognized and properly addressed. Consequently, the following courses of action represent selective communicative responses or initiatives which may be employed. They range in intensity from a phone call to termination for default action—which, while being close to the ultimate weapon, unfortunately fails to fill the need for required goods or services.

Three categories of communication may be used: telephone communication, written communication, and meetings. Each of these has inherent advantages and disadvantages. Management judgment in light of facts, inferences, and perceptions is essential in their application, but each of the following can contribute to correction of contract performance problems.

Using the Phone

Quick, flexible, inexpensive, well-planned telephone contacts may correct a troublesome situation. One's personality may be effectively projected, and results may be sensed immediately in some cases. Also, one's call may be transferred from desk to desk until the proper people are personally contacted for resolution of the issue. While the relative cost of using the telephone is minimal, the results can often be immediate. When the response is inadequate, the problem can be elevated quickly and appropriately.

For example, by using the telephone, in-depth understanding and discussion of troublesome issues can be effected. Dialogue with the administrative contracting officer (ACO) and his clerks can achieve far greater insight into contractual progress than reliance solely upon a routine "Production Progress Report" (DD Form 375). The ACO's depth of knowledge, interest, and involvement can be measured and redirected when it is determined to be inadequate. Discussions with the production

specialist who wrote the production progress report can be enlightening. It is often the production specialist who has the best understanding of the contractor's circumstances; he serves as the ACO's eyes and ears.

Also, the level of contract administration service (CAS) interest can be sensed through careful attention to what is said, and how. Should a discussion by telephone suggest a low priority of attention to a problem, the buying office can request increased surveillance, weekly status reports, or more stringent measures by the CAS. The program office can become a "squeaking wheel" by effectively using the phone to develop personal relationships and to solicit commitments to resolve and prevent problems. Supporting the CAS role as on-the-scene representative, or as an extension of the buying office, can pay dividends to the buying office.

When the contractor employs local representatives, contact with them may be appropriate. These contacts can provide needed assistance and insight far quicker in some instances than could be obtained through written communication. This avenue may be as effective as, or superior to, calling the contractor directly at his main operating location, since the local representative often has more flexibility and dexterity in working within the contractor's organization. Caution must be exercised to keep the contract administration activity informed when such contacts are made directly to the prime contractor.

Further, trade-offs and work-around alternatives can be explored effectively by telephone on a personal or conference basis. Consequently, the telephone is quite a cost-effective tool. Its use in an age of restricted travel budgets is also a welcome economy.

Remember, however, that documentation memoranda are essential to preserve an accurate "memory" of agreements, open items, opinions, and insights developed while using the telephone. Follow-up correspondence or documentation is often required to record oral transactions, for the mind is a fickle servant with restricted access.

Using Paper

Written documentation of oral requests, commitments, and discussions can pay handsome dividends as issues evolve. While such efforts are somewhat more costly than telephone contacts, they can invoke internal coordination, higher authority attention, and careful documentation of the program office position. Thus, while building the "corporate memory," a consensus of broad support is also developed.

A formal definition of contract administration expectations and responsibilities is usually achieved by issuing a letter of delegation and executing a memorandum of agreement in complex situations,[4] delegating duties between the buying activity and

---

[4]Air Force Contract Management Division, "AFCMD Memorandum of Agreement Management System," AFCMDR 800-11, 17 March 1977.

the contract administration activity, as suggested earlier. Having done this, the management assistance letter is a useful escalation of communications between operatives. The range of potential runs from addressing the ACO, the cognizant branch chief or the division chief, to the CAS commander. Under appropriate circumstances, contacts with contractor management are appropriate and productive in escalating attention to contractual issues or difficulties.

Exemplifying the success of such an approach is the Ogden Air Logistics Center (ALC) Procurement and Production Directorate's constant monitoring of contractor delivery schedules. Such monitoring helps to reveal trends of delinquency that impact on the Center's ability to fill field requisitions for spare parts. The fill rate measures support of weapon system readiness. Tailored letters are addressed to appropriate contractor management levels when delivery schedules are not met. The result is success in focusing corporate management attention upon contractual difficulties that affect deliveries for contracts now delinquent or due to deliver in the near term. Trends are noted in the letters, and the impact of late deliveries upon vital weapon systems is highlighted. Usually, the conscientious contractor will identify the causes and correct the delinquencies. Copies of the letters are sent to cognizant ACOs to maintain continuity of contract administration and ACO awareness.

There are also other opportunities for effective use of written communications in contract administration.

Occasionally the customer's needs may change, requiring a contractual modification to reduce quantities, amend shipping instructions, change transportation, or to revise delivery schedules. A termination for the convenience of the government may even be required. Such actions must be documented in the contract by written communication.

Another avenue of written communication offering answers to post-award problems is the Defense Materials and Priorities System. Authorized by the Defense Production Act of 1950, this mechanism directs the flow of materials and products to the nation's military, atomic energy, and space programs. The Defense Priorities System is a rating mechanism for establishing precedence on orders with industry, e.g., DX or DO, indicating the importance of the order. The precedence is fully extendable throughout the industrial chain of producers and may be advantageously incorporated into contracts and purchase orders. Orders so designated take precedence over commercial orders. Using the Request for Special Priorities Assistance, DIB Form 999, materials and labor scheduling difficulties can be reviewed. Bringing into play the powers of the U.S. Department of Commerce's Domestic and International Business Administration, Bureau of Domestic Commerce, to resolve production difficulties may assure delivery of required supplies. While this procedure is reserved for unusual circumstances, its potential is formidable. This action may be initiated by contractors or the government buying activity after routine

efforts fail to locate sources of supply, or to resolve other problems such as production scheduling. Often the suggestion of such action stimulates initiative and solutions not visible earlier. The DIB Form 999 is another written communication tool available for use.

Prior to award, during formulation of the contract, a criticality designator (SCD) code is assigned. Normally, program criticality and the Defense Priorities System ratings are central considerations in SCD determination. However, after award, should contractor performance indicate that an important contract is being neglected, causing it to impact other contracts as in the case of government furnished property, it may become appropriate to upgrade in writing the SCD code from "C" or "B" to "A" as the item becomes a limiting or pacing item in a major procurement. Some other means to provide criticality information and invoke more intensive contractor surveillance might also be taken in the form of a management inquiry. These actions are best done by written request. As a result of upgrading, closer attention can be expected by the administering DCAS or plant representative.

Following sufficient informal coordination and exhortation directed toward a deficient contractor, it occasionally becomes necessary to serve formal written warning in the form of a cure notice, a show-cause notice, or a forebearance notice. These letters to non-performing contractors, where the default clause exists, can protect the rights of the government and provide solemn warning to the contractor. Deadlines for compliance with the contract terms are included. The prospect of termination action is raised. Such written notification suggests the possibility of "divorce" action, should appropriate corrective action not be taken. In consequence, these notices warrant careful review by staff legal counsel prior to dispatch by the procuring contracting officer (PCO).

Use of the ultimate written communicative weapon, termination notices, may become necessary. In such instances the needs of the government customer may remain unsatisfied. Termination action may be a convenience for the government, possibly because of revised requirements, excusing the contractor of his responsibility. In such cases the government may be liable for reasonably incurred costs. In contrast, termination for default holds the contractor pecuniarily liable for excess reprocurement costs. The companions to termination for default are frequently costly delays in receipt of the needed supplies or services and litigation lasting many months. Consequently, a termination action is not to be applied casually.

Each of the foregoing written actions or tools has the advantages of tangibility and relative permanence. Carefully conceived correspondence may record exactly what is intended yet the cost in time, human energy, and equipment resources of written documentation should be weighed against the advantages to be realized when selecting a course of action.

Face-to-Face Communications

Sometimes personal contact, "eyeball-to-eyeball," adds the required emphasis and import to an issue of concern. A better understanding and greater commitment may result.

In the contract administration phase before and after awarding a procurement action, meetings, both external to the government and internal, may become necessary. Personal contacts by the contract administration office personnel with the contractor at the plants, both prime and vendor, may be priceless expressions of interest and sources of information. In such contacts the realities of contract performance attain a clarity impossible to achieve by less direct contact. A well-planned visit employing reflective listening and careful observation can pay handsome rewards in terms of problem anticipation, detection, and resolution.

The benefits of such plant visits are seen in a broad range of experiences. For example, the production specialist at a DCAS office visited a producer of F-4 aircraft parts prior to an important milestone only to learn that the contractor had failed to place a key purchase order. Also, discussions between an administrative contracting officer and a plant manager surfaced a recurring contractor production control communications roadblock. Each resulted in adequate corrective action.

On another occasion, by conducting a pre-award survey in the contractor's plant, the results of previous "arm-chair" surveys were expanded to accurately reflect limitations of a prospective contractor's capabilities.

Further, well-planned conferences between buying and contract administration activities often go a long way toward emphasizing areas of concern and toward developing genuine personal commitments to improvement. Such activities as annual conferences between DCAS and buying activities, program reviews with plant representative participation, and buying office visits to contract administration offices, may contribute significantly to a stronger dedication to the achievement of team goals.

Additionally, face-to-face visits between the buying office and the contractor merit a brief examination. Contacts at the program or project manager level occasionally fail to produce the desired results. In such instances, contact with the chief operating official of the plant, firm, or board of directors may become necessary. However, meetings between the PCO and the corporate contracts manager, or between engineers or other functional parties can also be quite productive. Written memoranda documenting the discussions and resulting actions are always appropriate. Also, an awareness of the provisions of the contract as well as the nature of pitfalls leading to constructive changes is essential to the government people in contact with the contractor.

Exemplifying the problem of constructive changes, a government engineer meeting with a contractor engineer may remark, "You're designing that switch over

here? We've always had it over there." The contractor's implementation of such a suggestion would likely result in a claim against the government for costs incurred to make the change. Consequently, representation for customer-contractor discussions may wisely include a contracting officer to avoid such issues which could add cost, delay delivery, or impact performance requirements of the contract.

When multiple contracts are involved or where a complicated contract is underway, periodic internal government and/or participating contractor review meetings can effectively cover a large number of issues at a low cost, while assuring a successful "partnership" with industry.

Finally, well-planned, in-house government meetings are essential to strike a unified government position and to negotiate differing positions or to direct a common position. Such mechanisms as management attention by holding meetings on source selection procedures, critical item management, data acceptance procedures, and Top 20, 10, or 5 Problem Reviews are tools available to the manager on a regular or *ad hoc* basis. Also, holding periodic general, internal reviews with accountable persons often serves to direct subordinates' attention to key areas to be discussed and resolved.

In a Nutshell

The opportunities for improved understanding, enhanced commitment, and problem resolution through the selective application of various communicative mechanisms are nearly limitless. Whether the telephone, written documents or face-to-face meetings are used, singly or in combination, communications can be tailored by the program manager to achieve effective contract administration resulting in satisfaction of the customer's needs. Careful documentation is essential to preserve the "corporate memory" and may play a major role in protests, claims or litigation actions. Yet prior to taking action, the advantages and disadvantages of alternative courses of action should be assessed. ||

37

THE TWO-TIER MATRIX ORGANIZATION IN PROJECT MANAGEMENT

Dr. William C. Wall, Jr.

The matrix organization integrates the program orientation of project personnel with the speciality orientation of functional personnel. In its original form, the matrix is a single-tier, project-oriented overlay on a functional organizational structure. Variations of the original form have resulted in a two-tier matrix—a matrix within a matrix. The use of the matrix form of organization in military project management is a familiar practice, but the two-tier matrix adds a new dimension to the concept. In large, complex organizations, the two-tier matrix provides for greater centralization of planning and control through definition of sub-projects. It substantially assists the project manager in accomplishing program integration by encouraging integration at the sub-project level.

The two-tier matrix is a double-decker in the project structure—a matrix superimposed on a matrix. It is a new organization form prompted by the continued growth of the complexities that bred the original single-tier matrix. The two-tier matrix is a response to the increasingly complex task of managing military projects.

The two-tier matrix is not an unproven concept. For example, organization has been cited as a major contributor to the success of the U.S. Air Force F-15 fighter aircraft acquisition program. The management structure of that system program office was a form of two-tier matrix.[1] The U.S. Army HAWK Project Office also has been recently restructured into a two-tier matrix organization.[2] Early indications are that this restructuring has improved management control and program integration. In both cases, implementation of the concept appears to have facilitated interaction among participants.

Single-Tier Matrix Design

The single-tier, or basic matrix organization design, evolved during the 1950s with the formal development of military project management.[3] The rapid growth of

[1]Gilbert B. Guarino, Relva L. Lilly, and James J. Lindenfelser, "Faith Restored—The F-15 Program," *Air University Review* 27 (January-February 1976), pp. 65–66.

[2]U.S., Army Missile Command, *HAWK Project Office Management System Plan* (Redstone Arsenal, Alabama: HAWK Project Office, 14 October 1976), pp. 1-2-1-3.

[3]An excellent comparative description of functional, project, and matrix organizations may be found in Robert Youker, "Organization Alternatives for Project Managers," *Management Review* 66 (November 1977), pp. 46–53.

Dr. William C. Wall, Jr., is Chief, Program Management Office, HAWK Project Office, U.S. Army Missile Materiel Readiness Command. He has worked in project management with the Department of the Army for over 20 years. Prior to his current assignment, he was responsible for the development, implementation, and operation of the SAFEGUARD Management Information System. He has served as senior management advisor on numerous government ad hoc *study groups and committees. Dr. Wall holds a B.S. degree in mechanical engineering from Lafayette College, an M.A. in public administration, and M.B.A. and Ph.D. degrees from the University of Oklahoma.*

technology in weapon systems since World War II and a desire to minimize development lead time have resulted in an increase in the variety of information inputs required by managers from the scientific, engineering, and administrative disciplines. As a consequence, the complexity of the management task has increased significantly in recent years. These factors gave rise to the concept of project management and to the single-tier matrix design.

The typical military project office is established to accomplish some specific mission or objective of measurable and finite duration. In this sense, a project office differs from the typical functional organization that assumes a "going concern" concept of enduring mission. Thus, the single-tier matrix layer on the functional organization is intended as a temporary overlay on the base functional organization structure. Typically, the project office staff consists of a myriad of skills or professions in an interdisciplinary array. The people are project oriented, devote full work time to the project, and are organizationally assigned to the project office. These people work directly for and are administratively subordinate to the project manager. The conventional military project office is not staffed to sufficient manpower depth to be self-supporting and must draw upon manpower from outside the office. This normally results in the acquisition of both organic and inorganic support. Organic support is provided by functional elements integral to the parent organization, typically a commodity command. Inorganic support involved is acquired from other government agencies and the private sector.

Figure 1 depicts a typical single-tier matrix consisting of six functional elements and three project offices. The directors of the functional directorates and the project manager report to a single individual—the commodity commander. The matrix design below these levels, however, suggests vertical, horizontal, and diagonal relationships among participants. It also suggests that many functional people operating in the matrix structure have two group memberships. The first is in their speciality or functional organization, while the second is in the single purpose or project environment. The single-tier matrix requires that these people serve two masters—the director of the functional directorate and the project manager.[4] In other words, the project manager and the functional director share the responsibility for directing the efforts of these individuals. The project manager exerts project direction while the functional director exerts traditional line direction over the same people at the same time.[5]

The project management office structure associated with a single-tier matrix is typically function-oriented and is illustrated in Figure 2, which depicts six functional

[4]For an analysis of the two-boss model see Stanley M. Davis and Paul R. Lawrence, *Matrix* (Reading, Massachusetts: Addison-Wesley Publishing Company, 1977), pp. 46–52.

[5]Grover Starling, *Managing the Public Sector* (Homewood, Illinois: Dorsey Press, 1977), p. 193.

Figure 1

SINGLE - TIER MATRIX

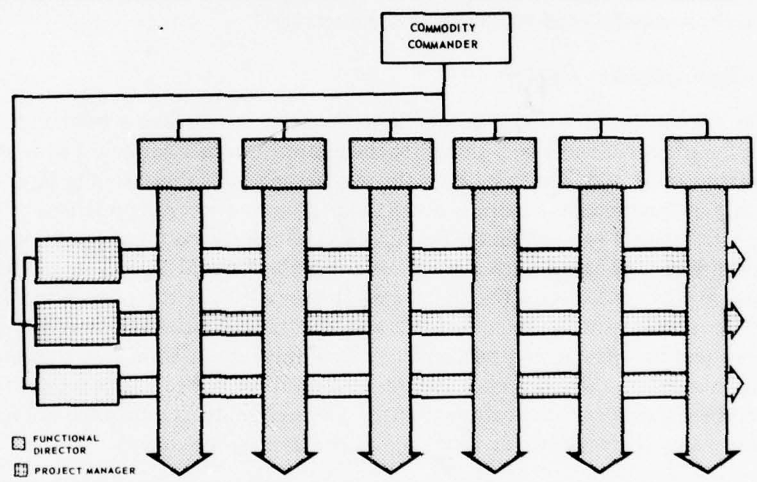
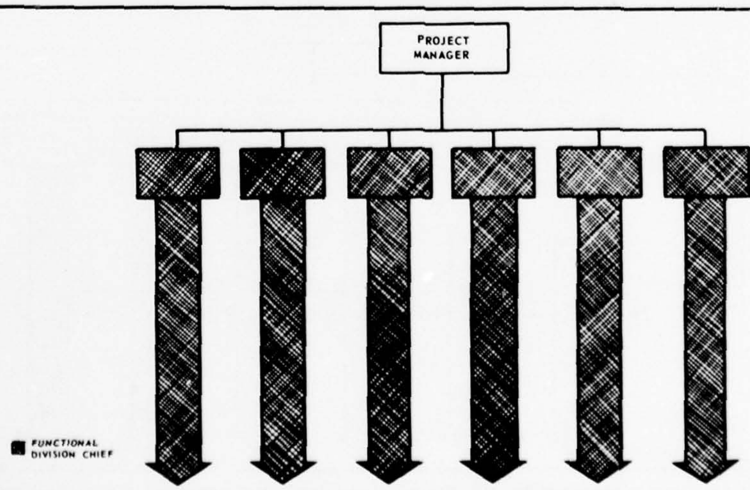


Figure 2

PROJECT MANAGEMENT OFFICE IN A SINGLE - TIER MATRIX STRUCTURE



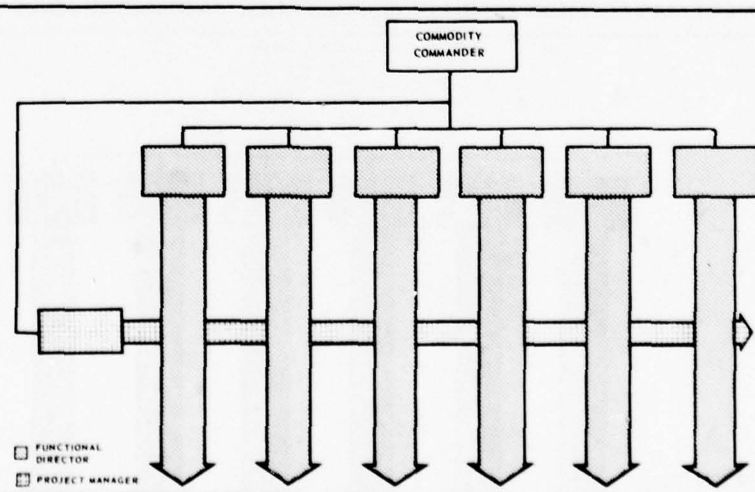
elements. Program focus is achieved through the natural interaction of personnel within the project, and through the personal drive, initiative, and entrepreneurship of the project manager. It is he, within the commodity command, who directly assures the successful production of goods and services.[6]

Two-Tier Matrix Design

The two-tier matrix design is simple in concept. It employs a matrix design within the project conceptually similar to the matrix structure employed within the commodity command. The first tier of the two-tier matrix is illustrated in Figure 3, depicting six functional directorates and a single project office. A comparison of this figure with Figure 1 reveals that the first tier of a two-tier matrix for a specific project office is graphically identical to the single-tier matrix design within the commodity command. The directors of the functional directorates and the project manager report to the commodity commander, and the same vertical, horizontal, and diagonal relationships among participants below this organizational level are suggested. In order for the differences to begin materializing, however, it is necessary to look at the second tier of the two-tier matrix. The second tier is illustrated in Figure 4, which shows six functional divisions and three sub-project elements.

Figure 3

FIRST TIER OF TWO - TIER MATRIX



[6] This thesis is developed in Marshall Dimock, "Revitalized Program Management," *Public Administration Review* 38 (May-June 1978): 199–204.

Comparison of Figure 4 with Figure 2 results in the immediate observation that the project management office organizational structure in a two-tier matrix is markedly different from the project management office in a conventional or single-tier matrix. Specifically, in the two-tier matrix, the project management office has an internal, horizontal focus not evident in the single-tier matrix. It is this horizontal orientation that materially assists the project manager in his role as program integrator. It is this horizontal or sub-project dimension that also differentiates the two-tier from the typical single-tier matrix. This innovation adds versatility to conventional matrix management while creating constructive, yet challenging, management interactions among the participants.

The second tier of the matrix is depicted in context with the first tier in Figure 5, where the complete two-tier matrix is illustrated. It may be seen that the two-tier matrix is not just another routine way of organizing a project management office. It is a significant departure from traditional designs and adds a new dimension to project management.

Two-Tier Matrix Management in Operation

The hierarchic or chain of command, the project, and the functional lines of authority in two-tier matrix management are highly complex. Figure 6 graphically

Figure 4

SECOND TIER OF TWO - TIER MATRIX

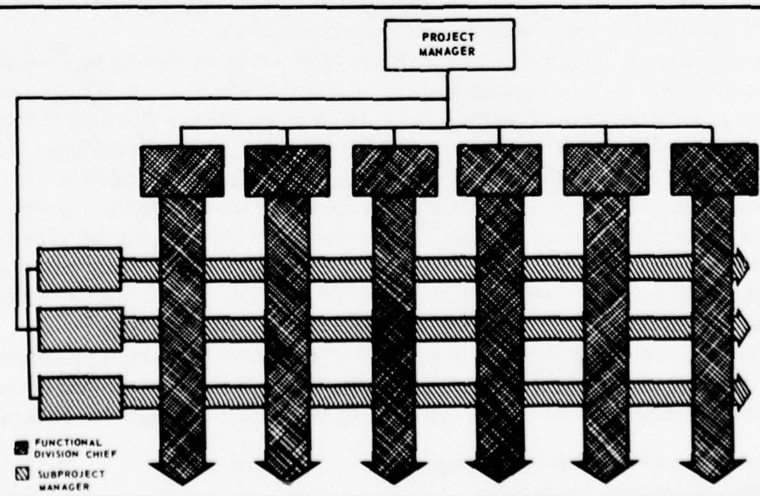
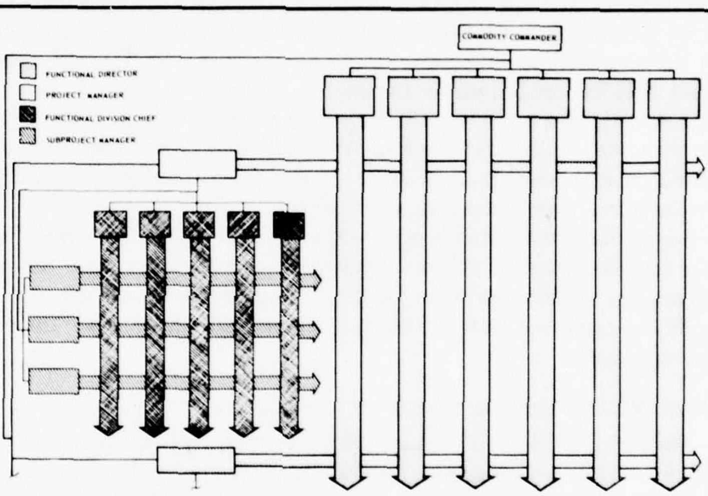


Figure 5
TWO TIER MATRIX



displays these relationships from the commodity commander down through the branch chief level—a total of four discrete levels of typical chain of command. A careful, point-by-point discussion of each of the participants' roles in the two-tier matrix structure will provide insight into these relationships.

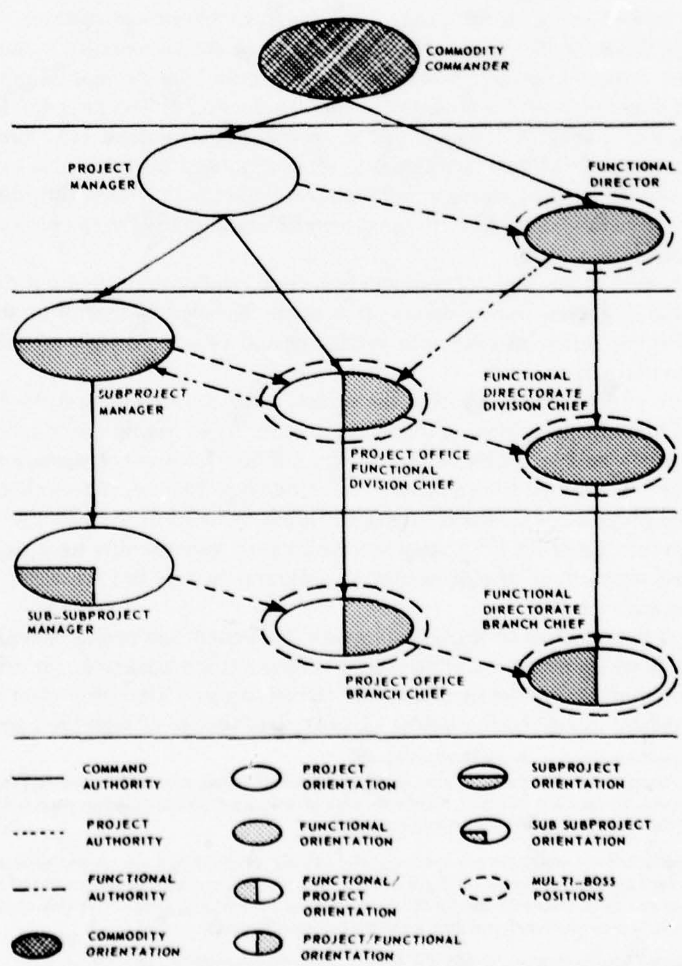
It should be recognized that although the commodity commander supervises the project manager and the functional director, both of whom are in the matrix, he himself is not a member of the matrix.[7] It is his responsibility to insure that both individuals perform their respective missions successfully and to adjudicate differences between them. The commodity commander has a corporate outlook. He does not share his power with anyone and he is solely responsible for the aggregate of weapon system programs comprising his commodity command mission. The commodity commander's position is a unique blend of project and functional responsibility. He facilitates the integration of the individualized, inward focus of project managers with the universalized, outward focus of functional directors.

The project manager depicted in Figure 6 is responsible for a single project made up of multiple sub-projects. For the sake of simplicity, only one sub-project manager and one functional division chief reporting to the project manager are illustrated.

[7]Davis and Lawrence, *Matrix*, p. 47.

Figure 6

CONCEPTUAL MODEL OF TWO-TIER MATRIX MANAGEMENT



The project manager is immediately subordinate to the commodity commander and unifies project affairs. He is at the same hierarchic level as the functional director organizationally, but he is authorized to control the activities of the functional director as they relate to his assigned project and within prescribed limits.[8] In other words, he has the authority to issue project direction to the functional director.

The functional director illustrated in Figure 6 is responsible for a total functional speciality such as procurement, product assurance, supply or maintenance. He, like the project manager, is immediately subordinate to the commodity commander. Unlike the project manager, however, his is a multi-boss position. He receives command direction from the commodity commander and project direction from all of the project managers assigned to the commodity command. The functional director provides functional facilitation to all projects and his functional authority may occasionally conflict with project goals. As Figure 6 illustrates, this functional feedback is generally directed to the next lower hierarchic level in the project office organization.[9]

To this level in the chain of command, the interrelationships do not differ from those of the single-tier matrix design. It is at the next level—that of the division chiefs—that the differences between single-tier and two-tier matrix interrelationships begin to emerge.

The sub-project manager within the project office is responsible for a discrete, separately identifiable element of the total program. As an example, one sub-project manager might be responsible for all foreign military sales of the weapon system, another for international co-production and technology transfer, and another for the U.S. Army program. This is essentially the breakout used in the HAWK Project Office.[10] In the case of the F-15 program, the areas of responsibility were associated with major segments of the development program such as the airframe, engine, armament, and training.[11]

Some of the principal criteria affecting establishment of sub-project managers are the degree to which program differentiation is required and attainable, the criticality of resource control, and the significance of the sub-project. The sub-project managers may operate as one-person offices or have small groups of high level personnel

---

[8]As an example, a project manager may direct a contracting officer to execute a contract for certain goods or services. He may not, however, dictate the type of contract since this determination is within the contracting officer's area of responsibility and authority.

[9]The feedback is not unlike the example suggested in the preceeding footnote. It also applies to fiscal resources in fund appropriations not managed directly by the project manager. In other words, the project manager may not be provided all the funds he requires by a functional director. In this example, the feedback would be from the functional director to the project office divison chief.

[10]U.S., Army Missile Command, *HAWK Project Office Management System Plan*, p. 1–5.

[11]Guarino, Lilly, and Lindenfelser, p. 65.

assigned to them to assist in carrying out their sub-project program responsibility. The creation of sub-projects focuses added intensified management within the project office. As indicated in Figure 6, the sub-project manager receives command direction from the project manager and issues sub-project direction to the functional division chiefs within the project office. As a practical matter, the relationship between the sub-project manager and the functional division chiefs in the project office is strikingly similar to that between the project manager and the functional directors.

The functional division chiefs in the project office are key individuals in the two-tier matrix. The ultimate success or failure of the concept rests largely on their shoulders. As indicated in Figure 6, the project office functional division chief positions are multi-boss positions. The project office functional division chiefs are subordinate to and receive command direction from the project manager, sub-project direction from the sub-project manager, functional feedback from the functional director, and issue project direction to the functional directorate division chiefs and functional direction feedback to the sub-project manager. The project office functional division chiefs are the focal points for information flow. They are the true integrators of the single-purpose special requirements of the project with the multi-purpose general responsibilities of the functional directorates. It is their duty to optimize the use of project resources, serve as interface between sub-project managers and functional directorate division chiefs, and minimize project uncertainties. They sit in the catbird's seat of project activity. Figure 6 also illustrates the next lower level in the hierarchy, and the interrelationships at this level are conceptually identical to those just described for the division chief level.

Implications of the Two-Tier Matrix

The matrix organization is considered an organization form of the future.[12]. The two-tier matrix is visible proof that project management of complex weapon systems is conceptually alive and well. It helps establish an organization structure with greater flexibility for responding to external pressures and influences. It creates interrelationships among participants that stimulate group initiative and enhance the group's ability to cope with the complexities of typical weapon system projects. This same mechanism tends to decentralize routine decision making by moving it closer to the points of action.

Many of the typical pathologies associated with the single-tier matrix design are equally evident in the two-tier matrix.[13]. On the other hand, the two-tier matrix

[12]Starling, pp. 191–194.

[13]For a description of typical pathologies see Stanley M. Davis and Paul R. Lawrence, "Problems of Matrix Organizations," *Harvard Business Review* 56 (May-June 1978), pp. 131–142.

forms the foundation for even greater utility in the project management concept. It extrapolates the single-purpose emphasis of the original matrix design without duplicating the functional capability contained in the project office. By providing a vehicle for concentrating planning and control at the sub-project level, the two-tier matrix encourages the grouping of similar program elements within the project. This aspect helps bring greater focus to major program elements of multifaceted projects and insures that desired management emphasis is afforded each.

The two-tier matrix design is not a panacea for poor or inept management. In fact, proper implementation requires extraordinary skill on the part of all concerned. Matrix managers face many challenges in the proper accomplishment of their assigned responsibilities, but the two-tier matrix design is a solid means for successfully conducting complex and urgent programs. Intensive management of selected weapon system programs remains essential. The two-tier matrix design is in harmony with this compelling need and underscores the continuing search for order in the management of large-scale, complex endeavors. ||

47

MANAGEMENT UPDATE: THE ARMY SCIENCE AND TECHNOLOGY PROGRAM

Dr. Marvin E. Lasser

The Army has relied for a long time on its science and technology program to provide a technological edge over its potential adversaries. As a result, the U.S. Army will soon have the best tanks, helicopters, and anti-tank missiles in the world. However, there are capability areas where we do not fare as well. For example, our potential enemies out-range us in artillery and have more capable air defense gun systems. We need to improve our technological capabilities so that we can achieve superiority across the board. We cannot settle for less.

We must insure that we get maximum return within the available funding levels. One way to do this is to place our trust in the people responsible for managing the Army's science and technology programs. Our systematic efforts to do this have resulted in a major decentralization of the management of Army long-term technology efforts.

The first step in decentralization was to provide the responsible Army laboratory director with a block of funds for a given fiscal year. The process for doing this is known as Single Program Element Funding (SPEF). Under SPEF, the laboratory director proposes a set of prioritized tasks and indicates what he expects to accomplish during the coming year. His approved program is then "block" funded and the director is held responsible for the performance of his laboratory. In this concept, the laboratory director is free to change his program at any time to take advantage of technological opportunities. The budget for each laboratory is strongly influenced by accomplishments in the previous year's program and the content of the proposed program.

Before SPEF, the laboratory director had considerably less control over what was done in his laboratory. He had little freedom to change projects since each work unit was funded individually. There were technical specialists on the Army staff who controlled the funds in their particular technical area. Washington-based specialists in propulsion, physics, meteorology, social sciences, medical services, etc., not only pushed their areas of expertise in competition with each other, but also controlled what was done in the laboratories in their areas of expertise. Laboratory directors were justifiably frustrated by this process in which they could not even move funds from the weaker programs to the potentially more promising ones without considerable administrative effort.

Delegation of authority to the laboratory director was often agreed to in principle but not readily adopted for several reasons directly related to imagined Congressional objections. One reason put forth was that if laboratory funds were combined into

Dr. Marvin E. Lasser has served since 1977 as Director of Army Research. He previously held the positions of Chief Scientist, Department of the Army, and Executive Director of the Army Scientific Advisory Panel. Before entering government service in 1966, Dr. Lasser held a number of research and management positions with the Philco Corporation. He holds a B.S. in physics from Brooklyn College, and M.S. and Ph.D. degrees from Syracuse University.

two program elements per laboratory, one in research (6.1) and one in exploratory development (6.2), then Congress would see them as new large programs and might make cuts, not recognizing a consolidation of many programs. Experience has shown this not to be the case. Congress has never cut a SPEF program because of its size. In fact, the biggest SPEF programs have fared very well in Congress. (Note: Since the Army 6.1 program consists of only two program elements, which are further divided into projects, the block funding for 6.1 is often referred to as Single Project Funding, or SPF.)

A second reason theorized was that Congress would object to what many thought would be a lack of visibility of program content. Again, this was not the case. By using SPEF, the laboratory director was better able than before to explain his program. He could now describe his program as a total entity and could readily portray how the various parts fit together. Advanced planning for SPEF was well coordinated with members of Congress and their staffs, and they gave the Army their full support.

Although the move to delegate authority via SPEF was a most important one, it was only one of a number of changes that were made to improve the R&D process.

The Problem

Clearly, the lab directors were happy to get the authority that went with SPEF. However, with authority came responsibility and the question, "What are the priority requirements my laboratory should address?" The answer to this question is provided by the Training and Doctrine Command (TRADOC), which speaks for the "user." When the problem materialized, the TRADOC organization was not geared to interface with the Army's science and technology program. Means had to be developed to bring the user and developer together early in the developmental process. It was necessary to encourage the user to articulate his needs in such a way that the laboratories could understand and respond.

The Solution

The vehicle developed to identify user requirements was the Science and Technology Objectives Guide, or STOG. The STOG is divided into capability categories and sub-categories as shown in Figure 1. Each major capability category section is a listing, in priority order, of the user's needs within that category. For example, in the capability category "other combat support," the highest priority need is rapidly emplaced minefields with specific characteristics such as variable time activation, remote deactivation, and firing based on discrimination sensors. The next priority Science and Technology Objective (STO) addresses improved equipment/techniques for detection and neutralization of minefields. Going further,

Figure 1
CAPABILITY CATEGORIES (CAPCATS)

TITLE	CONTENTS	TITLE	CONTENTS
Command Systems	Strategic Communications Tactical Communications Communications Security Automation Position Location Other	Air Defense	Low Altitude Systems Low/Medium Altitude Medium/High Altitude Systems Support
Intelligence, Surveillance, Target Acquisition (ISTA)	Strategic Intelligence/Mapping Signal Intelligence (SIGINT) Electronic Warfare (EW) Intelligence Support/ Weather Support Reconnaissance, Surveillance, Target Acquisition (RSTA)	Combat Service Support	Supply & Transportation Maintenance Energy Soldier Support/Food Service Medical Aviation Support
Close Combat	Tank Anti-Tank Mechanized Infantry Combat Aviation Light Weapons	Other Logistics	Construction Facilities Engineering Environmental Quality Control Administrative Vehicles Strategic Mobility
Fire Support	Mortars Cannon Artillery Rockets/Missiles Support	Program Wide Support	Training, Training Devices, Human Engineering Military Personnel Management Military Manpower Management Test Instrumentation
Other Combat Support	Combat Engineer Mine/Countermine Night Observation NBC Other (Airdrop; PSYOP; EOD)	Ballistic Missile Defense	

the next one describes airdrop system requirements. An important point to note is that these STOs are clearly user-oriented rather than developer-oriented. Each STO lists the user proponent most concerned with the objectives delineated, as well as the laboratory assigned primary responsibility to see that the STO is adequately addressed.

Each capability category also contains a background section, a discussion of the general capabilities required (e.g., rapid enhancement of mobility for friendly forces and a counter-mobility capability to impede enemy forces), and a concept of operations.

The purpose of the concept of operations portion is to provide the laboratory director with the "big picture" of what is to be accomplished. He can then better understand the prioritization of the STOs, which provides a basis for meaningful and innovative management as requirements change or as research opportunities become evident.

It is important to reiterate that the STOG is a requirements document reflecting the needs of the user. Notwithstanding this basic precept, the user community had to have help in preparing the document. One difficulty was that the TRADOC staff sometimes felt they could not properly reflect their future needs in a way the laboratory scientist could understand. It was a classic communications gap with the developer anxious to get requirements but not sure how to go about getting them, and the user holding the opinion (mistakenly) that there was no easy way to communicate needs in a way laboratory scientists would understand and be able to respond.

Another problem was the inherent difficulty of adequately defining requirements. Often the requirement cannot even be formulated without a great deal of communication between user and developer. Also, the requirements frequently change (or mature) during the course of effective user/developer communications.

Once started, the dialogue between the scientist and the user ran very smoothly. The first draft version of the STOG was prepared by the staffs of the Director of Army Research and the Deputy Chief of Staff for Operations and Plans (DCSOPS), but it was based on a draft of requirements that had been established in one form or another within the TRADOC community. It only needed a start.

The second iteration of the STOG, called STOG-78, was published in April 1977 and the third iteration, STOG-79, will be active until the next update in April 1979. Laboratory directors have used STOG to redirect their programs to the Army's highest priority needs, and management program reviews have used it as a basis to judge the responsiveness of laboratory programs to the Army's needs. Joint laboratory program reviews are held annually in the spring and it is noteworthy that the TRADOC representative is a key figure. He compares programs against the stated needs. This has a significant impact on program planning for the future. The STOG is constantly improved and refined in subsequent editions.

Caution

A caution which must be kept in mind in any discussion of requirements documents related to a science and technology base program is that if we try to define the goals for the *entire* science and technology program we are making a serious mistake. To do so would prove to be too constraining for a meaningful, productive program. We must leave room for innovation. The Army is sensitive to this concern. To quote from the executive summary of the STOG: "Nothing in this STOG is intended to depart from the essential SPF/SPEF management concept that R&D directors must determine where they can make the most significant science and technology contributions to the known or presently unforseeable needs of the Army."

It has been estimated that approximately 70 percent of the 6.2 exploration development programs should be in response to STOG objectives. The other 30 percent or so represents funds available for the laboratory director to use to pursue technological opportunities as they arise. Many new technological opportunities can be forseen by the laboratories as the SPEF plans are being prepared, and can be included in the plan. When opportunities for innovation become apparent after the annual plan is published, the director still has the freedom to readjust his program. At the end of the year he and his lab are judged on the efficacy of the overall program. The director does not have to adhere entirely to the plan he laid out at the beginning of the year; on the contrary, he can make meaningful changes. But he is also expected to address, wherever feasible, the highest priority needs that his laboratory can satisfy.

Management Review

Given the STOG and given the laboratory programs, management now has the requisite information to evaluate return on the science and technology investment. This is done by the Research Development and Acquisition Committee (RDAC) in preparation for next year's budget. Each proposed or current program is examined to determine:

- What assumptions lead us to work in the sub-capability category;
- What the major thrusts of the programs are;
- What the STOG calls for within the sub-capability category;
- What pacing problems the laboratories see;
- The work being done to solve each pacing problem;
- The laboratories doing the work, and;
- The dollar amount being spent on each problem area.

By reviewing by capability category rather than by laboratory organization, the Army's total program in a given functional area is readily identifiable.

Review by capability categories provides an excellent method for overview of that portion of the Army's science and technology program oriented towards solving problems stated in the STOG. It turned out (notwithstanding the guidance that a reasonable percentage of the program should be independent of STOG requirements) that over 90 percent of the 6.2 program submitted could be correlated with the STOG. It is not clear how much of this is a true reflection of the program and how much is a "forced" correlation to show relevance. The percentage was, of course, much smaller for the 6.1 program.

Careful study of the laboratory inputs showed few examples where the stated correlation with the STOG was unrealistic. This may well indicate that too much of the current 6.2 program is closely coupled to readily forseeable application. Further study of this aspect clearly is required.

Research, Development, and Acquisition Committee

The final step in the management process was the adjustment of funds based on the information organized by capability category. Balancing and readjusting R&D and procurement funds is normally carried out by a group known as the Research, Development, and Acquisition Committee (RDAC). This committee has representation from the R&D and operations communities, from TRADOC representing the user, as well as representation from the development organizations.

This year the RDAC added a special session that addressed the science and technology base exclusively. The review by capability categories provided the visibility and understanding of the program content, and this in turn enabled the RDAC group to make funding adjustments within the 6.1 and 6.2 program in a more meaningful and appropriate way.

It was clear to those participating in the RDAC process that the science and technology base is highly responsive to the needs of the Army. These programs can compete favorably for funds when compared either to major systems or to other systems that are well along in development.

Conclusion

The Army has developed techniques that have provided improvements in the management of its science and technology programs, based on the premise that we put the authority and responsibility for laboratory programs where it belongs—with the laboratory director.

If this authority is truly delegated to the director, he cannot then be told how to run his programs. Obviously, however, this does not mean that he cannot be helped with advice on what the Army needs.

This delegation of authority cannot be considered a blank check. It carries with it the responsibility to provide the Army a return on its investment, either from an individual laboratory or from a number of laboratories working in concert. By compiling the major program thrusts by capability categories it is possible to determine which areas are not adequately covered and therefore where additional emphasis is needed. This same display of program content clearly portrays the importance and relevance of the on-going programs, but when changes in program emphasis are required (found to be the case in only a small fraction of the total program) this can be done in a knowledgeable way.

SOFTWARE QUALITY AND PRODUCTIVITY

54

B. M. Knight

The quality assurance (QA) discipline has long been recognized as an effective tool for management in producing hardware systems. Only recently, however, have people asked the question, "Why not software, too?" In the late fifties, the military issued a QA specification that is the basis of almost every quality program used by contractors doing business with the government today. This specification, MIL-Q-9858A, Quality Program Requirements, was intended to cover all supplies and services when it was referenced in an item specification, contract, or order. However, the government now is viewing software as a separate deliverable item and, hence, subject to the requirements of the QA specification. This has presented something of a problem both to the contractors and to the Defense Contract Administration Service (DCAS), which is the government's QA organization. No one really knows how to apply MIL-Q-9858A as a software specification.

Twenty years of hardware-oriented implementation of the QA specification has created a tremendous inertia. Organizations have been built and people have spent their entire careers studying MIL-Q-9858A as it relates to a single step in a manufacturing process. A separate and distinct professional discipline has grown up within this environment. The government QA function also matured during this time. A cross-pollination process in the late fifties and sixties involving both government and industry personnel, in combination with the DCAS creation of the handbook for evaluating a contractor's quality program, created a "quality" community.

This community grew and prospered and began to speak a common language. The quality programs across industry took on a striking similarity, all based on a common understanding and approach to MIL-Q-9858A. This community did not address software because software was not a part of the problem. No one saw the trend that was developing. As hardware systems grew more powerful, so did the software systems that operated them. As program performance requirements grew, the size and complexity of programs also grew. This growth dictated more memory and processor speed. As the engineers responded with new generations of hardware, the programmers used it up and asked for more. There is a significant point to be made here. New and more powerful hardware generations have been born out of improved technology and engineering methodology. Programming, on the other hand, has not benefitted from any quantum strides in tools, techniques and methodologies. Then, as now, it was a laborious, intensive, artful endeavor. In spite of some innovations such as high-level languages, structured programming and the like, programming productivity has not nearly kept pace with the demand.

B. M. Knight is Quality Services Manager at IBM's Manassas, Va., facility. He is responsible for defining and implementing a software quality assurance program there and extending the quality concept to include reliability. Mr. Knight holds a B.S.E.E. degree from the University of Florida.

Further, we have seen a change in the cost ratio. Tremendous gains have been made in performance of digital hardware systems over the past twenty-five years. Hardware costs have gone down dramatically because the labor required to produce the new, higher performance hardware is no more and often less than that required to manufacture the old, lower performance systems. A commercial job mix of about 1,700 operations cost approximately $14.50 to run in 1955. Today, the same job costs approximately twenty cents. Moreover, the run time on this job has been reduced by a factor of 70.[1] The indications are that the hardware cost-to-performance ratios will continue to improve. Because of this, the Department of Defense, for one, is finding software to be by far the most expensive item in the inventory. At the spring 1977 meeting of the National Security Industrial Association Quality and Reliability Committee it was reported that DOD is spending more than $3 billion annually on specialized software alone.[2] This is considered a conservative estimate and does not include general-purpose automatic data processing software. A hardware-to-software breakdown of the total materiel system cost to DOD since 1955 shows an astonishing trend. Software cost as a percentage of total materiel system costs has steadily risen from less than 20 percent in 1955 to more than 80 percent today, and it is still increasing.

There are two basic reasons for this:

- *Size*—On the average, software systems today are an order of magnitude larger than they were 20 years ago. Memory has become cheap. An adaptation of Parkinson's law says that the number of program instructions will increase to the limit (and often beyond) of available storage. Therefore, the tendency is to keep adding function until the core is gone.
- *Complexity*—Not only have the software systems been packed with function, the functions and functional interfaces are increasingly more complex. The nature of the problems we are trying to solve with computer programs today did not exist only a few years ago. Consider the problem of detecting, classifying, and successfully defending against a large-scale ICBM attack. That was the problem faced by the system designers on an antiballistic missile program. They responded with one of the largest, most complex, most expensive systems ever developed. Consider the Navy's problem in dealing with the super submarines of today. Consider the complexity of today's business systems against 20 years ago or just 10 years ago. There may have been a time when there was an alternative to automatic data processing to keep our way of life whole, but not anymore.

---

[1] T. Z. Plaut, "Process Methodology: IBM's Approach to Control of Software Cost and Quality," *Software Project Management*, IBM Corporation, October 17, 1977.

[2] Barry C. DeRoze, "Software Management Within the Department of Defense," *Proceedings of the NSIA Conference of Software Quality Reliability*, March 30, 1977.

The demand for more, larger, and more complex programming is real and inescapable. Therefore, we must accept size and complexity as a fact of life, a part of the nature of our society, and learn to deal with it in a more systematic fashion. Today, it seems the only way to get more programming is to add more people, but more people cost disproportionately more money.

An interesting observation is that one reason programmable machines were invented in the first place was that an efficient and inexpensive way was needed to solve a variety of problems without changing hardware. It seems now we need an efficient and inexpensive way to solve a variety of problems without changing the software, because making those changes has become a very expensive proposition. Since we do not yet have the universal algorithm, we must continue to develop new programs and upgrade our old ones as the nature of our problems change. The challenge is to get the cost of software back into balance with total systems cost.

Life Cycle Cost

To put the problem in perspective, DOD is putting emphasis on understanding the total cost of a system over its life cycle, which allows the proper weight to be placed on cost of acquisition in the total cost equation. Many studies have been done which show that quality and reliability are major factors in the life cycle cost of software systems.

Dr. David S. Alberts, in a Mitre Corporation report, states that, conservatively, 50 percent of total life cycle cost is attributable to defects. Moreover, of the error types studied, he reports, "Design errors were found to contribute just over 80 percent of the total cost of error."[3] This represents a significant savings opportunity as well as a technical challenge. Perhaps even more significant than the potential for saving a large portion of the money invested in software is the possibility that, as is the case with oil, we may not be able to produce the software we need. Given that one-half of our programming cost is attributable to defects, then we may postulate that one-half of the programming population is not productively employed because they are engaged in finding and fixing errors. This means that the demand for programmers must grow at twice the demand rate for new program applications. Even assuming the demand for new program applications is constant, the programmer population will have to double each year unless we solve the productivity problem. We have already seen that quality is as much as half the problem; therefore, an effective QA program may provide as much as half the solution.

Failure Mechanisms

The effective QA program is one that is developed based on an understanding of software failures and the errors or defects that cause them.

[3]Dr. David S. Alberts, *The Economics of Software Quality Assurance*, MTR-5257, December 1975.

The mechanisms for software failure may be grouped into four basic error categories: functional specification, logic specification, code, and documentation. This grouping is convenient since it represents both the activity and the end product where an error may first appear. In Figure 1 we see an overview of some error mechanisms and their probable causes. We see that our natural difficulty in dealing with complex, abstract entities has been exacerbated by an imprecise technique in developing functional and logic specifications. Furthermore, insufficient attention has been given to what effect environmental conditions will have on the operability of the system after it is delivered. The development laboratory is a sterile, clinical environment. The real world generates data and conditions that are seldom considered when the functional specification is being created. Most experienced designers now avoid design decisions based on average data rates and do provide a safety margin; however, *they too often fail to include a design strategy that will allow the* system to continue to function when the instantaneous data rate or other conditions exceed the design margin. Depending on the mission, users may find this situation intolerable.

As is most often the case, if the cause of a problem has been correctly determined, the solution or corrective action is directly suggested. However, before corrective actions are taken it is prudent to review the error distribution and cost. This review will allow the proper priorities to be placed in the get-well scheme.

Figure 1

MECHANISMS FOR SOFTWARE FAILURES IN FOUR BASIC ERROR CATEGORIES

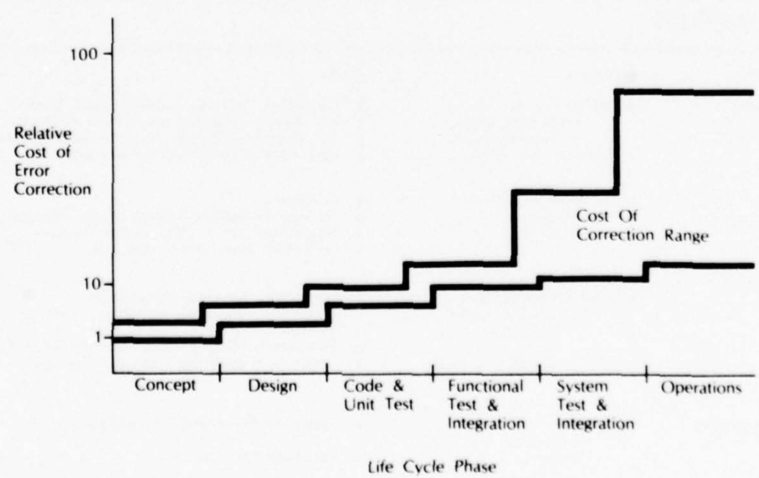
Category	Mechanism	Cause
Functional Specification	• Design/Human Error —Incomplete/Invalid Functional Spec • Environmental Stress	• Qualitative, Narrative Functional Spec Format • Assumptions Made But Not Verified in Design • No Numerical Reliability Allocation for Software • Environmental Conditions Not Considered
Logic Specification	• Design/Human Error —*Interface* —Algorithmic	• Complexity • No Way to Describe Abstract Design Efficiently • No Architectural or Other Design Standards • No Control Over Systems Resources
Code	• Process/Workmanship —Incomplete/Invalid Instructions Data Assembly (Compile/Build)	• Complexity, Language Interpretation • Programmer Discipline, Experience, Training, Competence, Time • Assumptions Made in Design Not Verified in Code • Defective Programming Tools and Procedures
Documentation	• Misuse —Operator —User	• Inadequate Documentation Standard • Inadequate User Training

Error Distribution

If we look at the error distribution in a large data base compiled over a number of years and across a number of programs, we see that 60 percent of the life cycle defects (that is, the sum of all defects recorded both during development and after delivery) are attributable to errors in the functional and logic specifications. For the purpose of discussion these may be grouped together and referred to as design errors.

Design errors are the major contributor to the quality/productivity problem. They represent 40 to 60 percent or more of the total defects and represent as much as 80 percent of the total error cost to fix. A primary reason for the high cost is that in the old-style programming process, design errors are typically discovered late in the test cycle, when they require more effort to correct. There is general agreement that the cost of correcting an error is a function of the age of the error. The cost to correct a design error late in the system test phase is at least 10 and as much as 100 times greater than the cost to correct the same error while still in the design phase (Figure 2). The age-to-cost relationship holds true for all error types—the later the find the more expensive the fix. This points to the strategy we can use to attack the problem—the strategy of prevention and early detection of errors.

Figure 2
COST OF ERRORS



Prevention Techniques/Improved Programming Technologies

Figure 3 shows the four basic error categories mentioned earlier with the causative factors repeated. The prevention techniques listed are by no means exhaustive or detailed, but they are representative of a host of improved programming technologies that are being used with increasing success today. While quality programs in the past have under-emphasized prevention of errors as a viable process, the notion that "getting a program right" rather than "getting it to work" is now in vogue. Dr. Harlan Mills, IBM Federal Systems Division Director of Software Engineering and Technology, in his paper on software development, says that "...getting programs to work is a by-product of getting them right." He further states:

> Since it is well known that no foolproof methods exist for knowing that the last error in a program has been found, there is much more practical confidence to be gained in never finding the first error in a program, even in debugging. Ten years ago this would have been dismissed as unreal. But it is happening with regularity among good programmers today.
>
> The reason program correctness is key to good program design is that a discipline of rigor is imposed in place of the currently widespread heuristics. Structured programming is marked by a stepwise refinement design process, in which programs are derived and validated as successive function expansions into simpler, more primitive functions. At first glance, stepwise refinement may simply look like an orderly, top-down sequence for inventing program statements, but there is more at stake in going from heuristic invention to rigorous derivation. What is at stake is a visible design structure that survives the coding, for use in maintenance and modification as well as implementation. Each refinement marks the top of a hierarchy which can serve later as a new intermediate starting point for verifying correctness or adding capability to a program.[4]

The improved programming technologies have been implemented in the IBM Federal Systems Division. Mixed results have occurred in some cases because of a large variation in understanding of the techniques among programmers and programming managers. Programming managers are naturally hesitant to change a process or technique that has been successful in the past. However, old methods are no longer appropriate because we are looking at success in a new, more quantifiable way. The new measure is how a program will perform over its life cycle, not just development cost and schedule.

In our drive to reduce overall programming cost, we must build the attitude to utilize the improved programming technologies with the rigor intended. This is the

[4]Harlan D. Mills, "Software Development," *IEEE Transactions on Software Engineering*, Vol. SE-2 No. 4, December 1976.

Figure 3

CORRECTIVE ACTION: ERROR PREVENTION

Category	Cause	Prevention Technique
Functional Specification	• Qualitative, Narrative • Assumptions Not Verified • No Numerical Allocation	• Quantify Functional Parameters • Stepwise Refinement Process • Contract for Operability/Reliability Demonstration with Specified Failure Criteria
	• Environmental Conditions	• Develop Error Handling Design Based on Mission Profile
Logic Specification	• Complexity • Abstract Design Description • Unproven Design Technique	• Hierarchical Program Structure/Top Down Development • Program Design Language • Design Standards at Module, Function and Program Design Levels
	• System Resource Control	• Lead Programmer Allocates Memory, Processor Timing I/O With 20% Reserve
Code	• Complexity • Programmer —Discipline —Experience —Competence —Time (Schedule)	• High Order Language/Structured Programming • Management Control —Quality Assurance Checks —Programmer Teams — Training — Development Plan Based On Productivity Rates — Interactive Development Facility — Programming Support Library
	• Defective Tools and Procedures	• Certification, QA Control of Support Programs, Procedures
Documentation	• Inadequate Standard • Inadequate Training	• Adopt NAVSECINST 3560.1 or Equivalent • User Personnel Conduct Operability Demonstrations

only way we will achieve the full potential offered. However, it is not all attitude. The Federal Systems Division has recognized that consistent, efficient implementation of improved programming technology must be based on a common understanding of, and approach to, these new methods. Consequently, a software engineering education program has been implemented which is aimed at bringing every programmer and programming manager up to a common understanding of, appreciation for, and ability to apply a rigorous engineering approach to designing and implementing software systems. This program goes back to basics. Starting with elementary logical expression, it proceeds through systematic programming and systematic design courses and workshops. Mills says, "We build programs from the top down but should learn programming from the bottom up." Universities have provided much of the research for the software engineering discipline but generally have not yet developed undergraduate curricula to specifically deal with it.

The new emphasis on QA with improved programming technologies for error prevention, even with inconsistent application, has shown some encouraging results (Figure 4). Twenty-eight errors per thousand source lines of code seems very high, but programmers have been traditionally tight-lipped about how many errors they find and fix in debugging a program, and even after the program gets into test, the actual number of problems has not always been reliably recorded. The numbers

Figure 4

ERROR DISTRIBUTION WITH PREVENTION MEASURES

	Life Cycle Defects/KSLOC*	
Category	**Previous**	**Current**
Functional Specs	17	12
Logic Specs	17	6
Code	13	6
Documentation	8	4
	55	28

*10^3 Source Lines of Code

shown in Figure 4 represent an honest attempt to count and classify all errors found during both the development and operational phases of the program life cycle. However, the reduction in error rate from 55 to 28 errors per thousand source lines of code is still very significant and we should begin to see an inflection in the software cost growth curve if these results are sustained and improved. Obviously, functional specification errors, which are in general the most costly to correct, have seen the least improvement. The lack of improvement in functional specification error rate is due, perhaps, to the fact that developing functional specifications is still largely an interpretive process. The functional specification process lacks the precision we have seen developed for logic design through the use of the graphic rather than narrative technique. This is an area where additional new techniques and innovations are required.

Defect Detection

After a full measure of prevention has been applied to the development process, we must still deal with the possibility that errors have been made. Errorless programming is still an academic topic rather than common practice, at least for the present. As previously shown, the earlier a defect is detected the cheaper it is to

correct. Not only is it cheaper, it is really more correctable. How often have we seen a less than optimum fix installed because there isn't money, time, or ability to go back and reprogram correctly? There are still many systems in the military whose target machines are very efficient for the application, but terribly inefficient as a development base. Sometimes days, or even weeks, are required in an inefficient environment to turn around new source code and do a system build. As a consequence, there has been a high reliance on object patches as a means of getting in a fix quickly. Unfortunately, patches sometimes create a bigger problem than they solve. Patches seem to beget patches, and eventually continuity or correspondence with the source is lost. Hence, if errors are found immediately after coding a module, the fix is usually not difficult and only the original compilation is lost. Programmers have always felt it easier to debug their code on the machine using test cases that they themselves have generated, but new evidence shows that it is not easier. Testing most often only shows that there is an error, or unexpected results. It does not pinpoint the source of the error. The test may provide a clue, but the final analysis and discovery is done by the programmer with the listing, reading the code. If this is true, then why not read it in the first place? Code reading has often been practiced by programmers with good results. We now understand, however, that going one step further will yield even better results. The code should not only be read, but inspected. This should be done by a team that has been given a road map to follow and some time to prepare. A moderator should be assigned to conduct the session, and accurate records of the findings must be kept. The programmer should follow up on the corrections made to the code before it is allowed to enter the test and integration process.

The notion of code inspections as an efficient detection process has been put forth by Mike Fagan, who has written extensively on the subject and has provided good data to support his conclusions.[3] Fagan has not only shown that the inspection technique is good for code but has proposed it as a design evaluation/error detection tool as well.

Design and code inspections have been implemented on several large programs in the Federal Systems Division of IBM and the results have been found to compare quite favorably with those published by Fagan. Figure 5 shows some results on three programs. A learning process in the inspection technique is evident because all three programs were similar in size, complexity, language, and application. The programmers also had a similar level of expertise; hence, it was felt that the code should have been of similar quality. Yet, on the first attempt the inspection team found more benign error types, violations of rules, standards and conventions than were found of

---

[3] M. E. Fagan, "Design and Code Inspections to Reduce Errors in Program Development," *IBM System Journal*, 1976, p. 182.

Figure 5

CODE INSPECTION ERROR OCCURRENCE PERCENTAGE

	Samples			
Error Type	**A**	**B**	**C**	**Fagan***
Coding Logic	9.75	33.33	42.11	26.4
Code Comments	4.88	13.79	11.90	6.6
Language Use	0.0	4.60	9.62	12.9
Storage Use	0.0	10.73	9.37	0.3
Design Error	4.88	6.51	6.66	22.1
Interface	0.0	8.43	4.89	5.5
Performance	4.88	10.73	4.13	2.9
Standards	60.98	4.98	4.05	0.0
Other Coding Errors	4.88	1.91	3.38	0.0
Test & Branch	9.75	3.45	1.35	2.0
Documentation Prologue	0.0	0.77	1.27	14.9
Maintainability	0.0	0.77	0.76	4.0
Flow Chart	0.0	0.0	0.51	2.1
	100.00	100.00	100.00	100.00

*IBM System Technical Journal No. 3, 1976

the malignant error types (for example, logic errors). Note that this technique was not received enthusiastically since some programmers are extremely reluctant to make public their code before they are sure it has been completely debugged. However, early publication of the code is exactly what we wish to encourage. When programmer and machine time are considered, unit testing or machine debugging by the development programmer is beginning to look like one of the least efficient removal techniques in terms of the number of defects found. The effectiveness of unit test is very difficult to measure because it has always been considered the programmers' personal domain, and they do not wish to change it or have others infringe upon it. We really do not have enough data at this point to summarily dismiss unit testing completely in lieu of inspection. However, most of the changes to a program during the unit test phase seem to involve more style than substance, making the program better rather than making it right (at least in the eyes of the programmer).

Defect Detection Process

The list of defect detection processes commonly used in many Federal Systems Division programs is shown in Figure 6. Design and code inspections are the newest additions to this list and from an early detection point of view seem to offer the greatest potential. Traditional test programs usually find only about half of the total errors created, which means that without the additional reviews and inspections the number of latent errors delivered may be quite high.

A general error detection profile which might be expected with the implementation of the reviews, inspections, and tests from the previous list is shown in Figure 7. Obviously, if the efficiency of inspections can be increased, the resultant increased slope on the detection curve will have a significant positive impact on the development schedule and life cycle cost. If most of the errors are removed before the test cycle, the cost of this most expensive part of the development program will go down significantly since most of the test time and effort is devoted to finding and fixing errors.

The effect of improved programming and defect removal techniques can be seen in Figure 8. The potential for improvement is clearly a function of how rigorously these methods are employed. Users of these techniques are already seeing the benefit. Continued emphasis on more rigorous implementation of these basic methods will take us well along toward the goal of zero defects, and will have a positive effect on programmer productivity. These will, in turn, lead to lower life cycle cost for software systems. ||

Figure 6

DEFECT DETECTION PROCESSES

- Function Spec Review
- Logic Spec Review
- High Level Design Inspection (I_0)
- Detailed Design Inspection (I_1)
- Detailed Code Inspection (I_2)
- Unit Test (Module)
- Integration Test (Subprogram Function)
- System Test (Program)
- System Design Certification Test
- Operability Demonstration
- Reliability Demonstration

Figure 7

Reliability Growth in Development

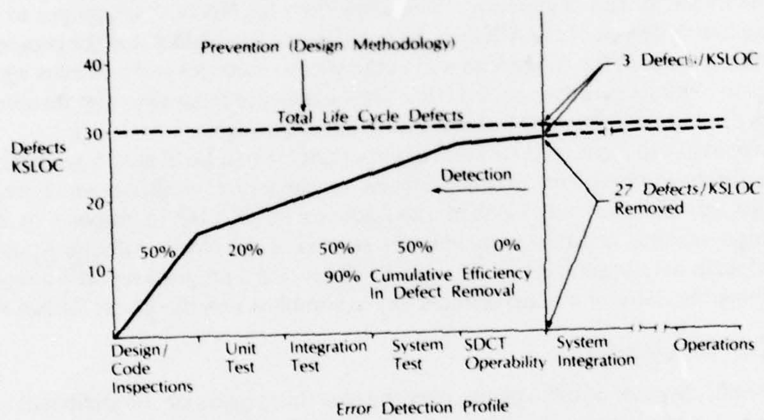


Figure 8

MODERN PROGRAMMING PRACTICES AFFECT SYSTEM QUALITY, RELIABILITY AND PRODUCTIVITY

	Defects/KSLOC Life Cycle	Defects/KSLOC Post SDCT*
• Old Style —Bottom Up Design —Unstructured Code —No Defect Removal Steps Prior to Unit Test —Regular Test Cycle	50 – 60	15 – 18
• Modern Practice — Top Down Design — Structured Code — Full Design Reviews and Inspections — Top Down Test and Integration	20 – 40	2 – 4
• Future Improvements — Improved Design and Programming Aids — Software Engineering Methodology — Proofs of Correctness	0 – 20	0 – 1

*Software Design Certification Test

NEW DIRECTIONS FOR NATO

66

Dr. William J. Perry

Nearly thirty years ago, the North Atlantic Alliance united 15 democratic nations bound by a common desire to oppose aggression and provide a future of liberty and freedom for their children. History records this as a most successful alliance—no other has brought together so many independent nations for so long.

The theme for this conference, "New Directions for NATO," is apropos to the coming fourth decade of the Alliance. The conference has highlighted the prospects for future success of the Alliance as well as the serious obstacles and problems which remain to blunt its effectiveness. It is time for the Alliance to move in new directions if we are to sustain liberty and freedom into a fourth decade.

I would like to focus on three areas of importance. First, I will issue a general call to quarters to emphasize my personal concern for the serious challenge which we, as an Alliance, face. Second, I will discuss actions for NATO to respond to this challenge—actions aimed at sustaining the success of the North Atlantic Alliance into a fourth decade and beyond. Finally, I will provide a progress report—a report describing the status of initiatives underway to stimulate new directions for NATO.

A Call to Quarters

The effectiveness of the Alliance over the past thirty years can be attributed to a common political purpose supported by military and economic strength. This combination has provided a shield to deter aggression, allowing the development of independent, vigorous economies which have provided a fuller and more prosperous life for the citizens of Alliance nations.

Under this shield of strength, the Alliance has been able to "go it alone," placing the economic interests of each independent nation above the interests of a strong and effective Alliance. In contrast, the Soviet Union and the Warsaw Pact have focused not on independence and consumer goods for their citizens, but on monolithic power building. The Soviets have been spearheading this effort, having increased their defense expenditures at a compounded rate of 3–4 percent per year for nearly two decades. They have overcome a 10-to-1 inferiority in the central strategic balance, having now reached essential equivalence.

In this environment of essential equivalence, the strength of our conventional forces becomes more important. But the strength of Alliance conventional forces is

---

This article is based on remarks prepared for delivery by Dr. Perry to the Aviation Week and Space Technology Conference, Brussels, Belgium, on June 26, 1978.

Dr. William J. Perry is Under Secretary of Defense (Research and Engineering). Prior to assuming his current position he was President of ESL, Inc., and Director of ESL Laboratories. He has served on scientific advisory committees for the Department of Defense and the National Security Council. His advisory role began in 1960 when he sat on a panel to study the "missile-gap" issue, and later included a study of verification problems in Strategic Arms Limitation Talks. Dr. Perry holds B.S. and M.S. degrees in mathematics from Stanford University and a Ph.D. in mathematics from Pennsylvania State University.

being challenged by the same program of Soviet power building. While I believe our deterrence remains viable, the trends will give us cause for concern during the fourth decade of the Alliance.

The conventional military strength of NATO *vis- a-vis* the Warsaw Pact may be viewed as a moving pendulum. While the position of the pendulum today continues to reflect the fundamental strength of the Alliance, the momentum of the pendulum has been in the direction of the Warsaw Pact for some time, and it continues in that direction.

In comparing the quantity of equipment deployed by the Alliance with that of the Warsaw Pact, we have become accustomed to a 2-to-1 or greater numerical advantage by the Warsaw Pact in most weapon categories. In the past, much of the Warsaw Pact equipment was outdated and inferior in quality, and we could sustain deterrence on the basis of the clear qualitative superiority and diversity of our weapons. But the sustained program of Warsaw Pact power building has begun to erode our previous qualitative edge in many types of equipment.

Consider, for example, Warsaw Pact ground forces opposite the NATO Central Region. About three-fourths of the older T-54 and T-55 medium tanks in the region have been replaced by more modern T-62 and T-64 models. Other significant new systems include the T-72 tank, the innovative BMP infantry combat vehicle, self-propelled artillery, and a number of organic air defense systems. The new artillery includes a mobile multiple rocket launcher, and self-propelled 122mm and 152mm guns. Organic air defenses include the ZSU-23/4 fully-tracked, radar-assisted anti-aircraft guns, and five types of mobile or man-portable surface-to-air missiles.

Much of this new equipment is comparable to or better than equipment deployed in NATO today. Furthermore, the equipment is generally compatible and interoperable, since standardization between nations in the Warsaw Pact is imposed by fiat. In contrast, NATO ground forces depend upon armaments that cannot, in many cases, be used, supplied, or maintained by Allied forces aside from the country that developed them. For example, a recent General Accounting Office report noted that of 208 items used in a NATO army group, very few are common to all four national forces in that group, and the bulk are unique to individual forces.

Turning to tactical air forces in the Central Region, NATO is again at a nearly 2-to-1 numerical disadvantage. But the qualitative superiority of NATO tactical air forces, superior pilot training and maintenance, and the ability to rapidly deploy U.S. tactical air forces to Europe largely redress this disparity. Yet, looking to the future, there is cause for concern.

The Soviet Union is modernizing its air force with technologically improved aircraft. In the past, Soviet tactical air forces have been dedicated to primarily defensive roles. But modern Soviet air forces, equipped with MIG-23s and 27s, and SU-17s and 19s, have substantially improved range and payload capabilities. The

result is a new capability for deep air superiority and interdiction, providing the ability to attack high-value targets such as command centers, stockpiles, and ports in Western Europe. We believe that the avionics and electronic warfare capabilities of these aircraft have been upgraded, placing them on a par with the F-4.

Again, the concern is with momentum—as the Soviets maintain production advantages that are typically 2-to-1 for most modern equipment; as they improve the quality of their equipment; as they expand the diversity of equipment and deploy it to Warsaw Pact forces which are standardized and interoperable, the deterrence of the Alliance may be tested. The principal challenge in the fourth decade of NATO will be to offset this Soviet power building and restore the momentum of the Alliance.

This challenge is a serious one—but one which we can meet given the will and determination to act efficiently on an Alliance basis.

Actions in Response to the Challenge

To respond to this challenge, we need not match the Warsaw Pact man-for-man or gun-for-gun. We should, instead, rely on our fundamental strengths and exploit the fundamental weaknesses of the Warsaw Pact. Some of our fundamental strengths are displayed by comparing NATO and Warsaw Pact assets. NATO has nearly a 3-to-1 advantage in gross national product and a 3-to-2 advantage in population. These ratios underscore the fundamental strengths of the aggregate Alliance economic, industrial and personnel resource bases. I believe the following four actions are necessary to exploit these strengths:

1. Increase Defense Expenditures Three Percent Per Year in Real Terms.

Increased expenditures would stop the continuing erosion in real Alliance defense budgets and enable the Alliance to respond to the steady growth in Warsaw Pact defense expenditures over the past two decades. Looking to the future, three percent per year may or may not be enough to equal the future increases in Warsaw Pact expenditures. We don't know what those increases will be. While a three percent per year increase in expenditures will not in itself redress the military balance, it is a substantial increase for democracies to make in light of competing requirements, and I believe it is an increase that is likely to compensate for the adverse trends in the NATO-Warsaw Pact balance if these expenditures are used efficiently on an Alliance basis.

2. Make Better Use of Defense Expenditures Through Cooperative Research and Development.

The lack of effective coordination and cooperation within the Alliance causes the whole of our defense output to be less than the sum of the contributing national inputs. Our equipment is not standardized and often not interoperable. We find

examples of limited technological quality and high unit costs due to small and inefficient national production bases.

Cooperative research, development and production can have a major impact on both the economic and military effectiveness of the Alliance. In the near term, cooperation can improve the quantity and quality of equipment by minimizing redundant R&D and providing economies of scale in development and production. In the long term, cooperative R&D will improve the interoperability of our forces as standardized equipment is developed and deployed in the field. Furthermore, standardized equipment will return additional benefits by providing economies of scale in logistics support and maintenance, thereby reducing support personnel and the cost of operations.

The advantages of cooperative R&D have been recognized for some time, but the principal stumbling block has been the protection of individual economic interests. Previous experience with standardization has led our European allies to link cooperation with "buy American." I would like to convince each of you here today that the future of the Alliance rests on increased cooperation on the basis of a genuine two-way street.

U.S. industry, and to some extent the U.S. Congress, perceive that increased cooperation with NATO means selling less of our equipment to Europeans, thereby losing the economic benefit. They further perceive that the impetus for a two-way street derives from the Department of Defense.

As I see it, the Department of Defense is simply being realistic in responding to the changing European attitude. I don't believe that Europe will accept 10-to-1 procurement ratios in the future. In fact, an Independent European Program Group has been established to rectify this imbalance, and they are taking action to do so. So given that the balance is going to change, our actions should be directed to bring about change in a manner that improves NATO effectiveness.

Constructive solutions to this problem will recognize that the European defense industry is capable of undertaking growing responsibilities in both prime and subcontract roles. Europe has a legacy of expertise in the science and technology of defense material. But the market within an individual nation has generally been insufficient to warrant investment in facilities and research on a scale compatible with efficient production on a trans-Atlantic basis. A successful program of cooperation will recognize these fundamental characteristics and their implications for a true two-way street.

3. Improve Application of the Alliance Technology Base.

The 3-to-1 Alliance advantage in GNP underscores our fundamental advantage in industrial base and supporting technology. There is no doubt that our fundamental industrial technology is dramatically superior to that of the Warsaw Pact—yet we

find very adequate technology in their recently deployed equipment. They are evidently putting their best technology in military equipment and making good decisions about where technology is important.

While we have substantial leads in components of technology, we have not been effective in translating this lead into deployed equipment—and we are seriously deficient in applying our technology effectively on an Alliance basis. We are simply not organized to apply NATO industrial technology to efficiently support NATO military effectiveness. To stimulate effective application of our aggregate technology base, we need to improve industrial cooperation and technology sharing. We need to extend technology sharing to all levels—from the most basic equipment to the most sophisticated.

In an effective program, the United States will bear a special responsibility for leadership. In protecting the security of the United States, we have developed procedures to protect our technology base. These procedures may act as hurdles to an ally who wants to cooperate with us. We need ways of either eliminating or at least reducing the height of the hurdles, so that we can improve the application of our mutual technology base on an Alliance basis.

Status of Initiatives to Stimulate "New Directions"

A foundation for new directions is provided by the Long Term Defense Program adopted by the NATO Summit in May. This program is a beginning that, one year ago, I would not have thought possible considering the comprehensiveness, detail and response to military needs reflected in the plan. As a vital underpinning for this plan, most NATO nations have confirmed their intention to increase real defense expenditures at the rate of three percent per year over the next several years.

The heads of government have also endorsed a program of greater Alliance cooperation to increase collective efficiency. This program contains a variety of initiatives intended to broaden the basis of cooperation. Our intent in these initiatives has been to encourage free market "pull" for greater cooperation as opposed to government "push." We are attempting to remove many of the barriers to trans-Atlantic industrial relationships, and clear the way for several alternative approaches to effective cooperation.

The traditional approach has been the development of a cooperative program for each specific project. Examples of recent progress taking this approach include the following:

Global Positioning System

A Memorandum of Understanding (MOU) was approved at the April Council of National Armament Directors (CNAD). This MOU provides for joint participation in the NATO Global Positioning System (NAVSTAR), emphasizing the design and

application of common user equipment. Participants include Belgium, Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, the U.K. and the U.S. The Global Positioning System offers an extremely efficient means of supporting NATO forces at all levels with greatly improved navigation information.

JP-233 Munition

The U.K. and the U.S. are sharing the expense of developing the JP-233 munition, with the actual development work taking place in the U.K. In May of this year, the U.K. and the U.S. committed to full scale development of this munition, which will provide an important capability to deny the use of Warsaw Pact aircraft through airfield attack and runway cratering. Other nations are being invited to join the cooperative program.

XM-1 Tank Gun

Since 1973, the U.S. Army has engaged in a cooperative effort with the U.K. and Germany to seek a common, optimal tank gun for NATO forces. In January of this year, the Secretary of the Army recommended that the German 120mm gun system design begin U.S. development and testing to adapt it for the XM-1 tank. The objective is to allow the first line tank forces of the U.S. and the Federal Republic of Germany to use common ammunition.

Modular Forward Looking Infra Red Systems

The U.S. and Germany have completed an MOU on the Modular Forward Looking Infra Red (MOD FLIR) which became effective in April. The near term objective is to maximize common use of MOD FLIR systems and modules by U.S. and German armed forces. In the long term, we believe this program will impact on FLIR systems in all NATO forces, providing the military advantages of modern night vision devices, the economic advantage of shared development, and the operational advantages of interoperability.

Improved Sidewinder Missile

In October of 1977, Germany and the U.S. completed an MOU to co-produce the Improved Sidewinder Missile (AIM-9L). Implementing arrangements are nearing completion and the way has been cleared to permit the transfer of production data from Germany to Norway and the U.K. With that step, we will be on our way to the start of the European Sidewinder Co-Production Program.

While these examples illustrate recent progress, working out a cooperative approach for each specific project is often difficult and deliberate. Consider, for

example, the efforts associated with the F-16 and AWACS. While this alternative is welcome where it is achievable, I believe a "package" or "family of weapons" approach offers far greater opportunities for successful cooperation.

The package approach is based upon identifying a weapon or weapons family having considerable operational flexibility within a broad operational concept. The next step is to identify countries or groups of countries to fund and develop the individual weapons in the package The fundamental idea is to improve the probability of cooperation by broadening the basis for cooperation—broadening the weapons considered as well as the countries interested in participating.

This package concept provides a mechanism compatible with a two-way street, and a mechanism which allows the Alliance to benefit from comparative advantages based upon previous experience or capital investments.

As an example, consider ship-to-ship missile systems for which France, Germany, the U.K. and the U.S. have a common interest. A potential approach would be to develop long and short range versions of the missile. After noting common requirements, the U.S. might undertake development of the long range version and the U.K. might combine with France and Germany to develop the short range version. At the completion of development we would make our developments mutually available for licensed production or two-way purchase to support efficient production runs. Key to this approach is harmonizing requirements early in the acquisition cycle. We believe the Periodic Armaments Planning System (PAPS) being developed under the CNAD will help in this respect.

We are currently exploring packages in several mission areas, including air-to-ground munitions, air-to-air missiles, anti-tank guided weapons, and anti-surface ship missiles. We believe that this package approach can provide a new and fundamental thrust to bring about effective and efficient cooperation in the spirit of a true two-way street.

Another means of progressing on the two-way street is to offset NATO purchases of U.S. military equipment. We have examined purchase of administrative vehicles for use by our forces in Europe, and determined that we could save 3–5 percent in life cycle costs by purchasing the vehicles in Germany. In May of this year, we announced the initial award for 225 vehicles. The total program is expected to involve more than 10,000 vehicles costing more than $100 million.

While we have much to do, there has also been progress in a framework for technology sharing. In the relevant policy statement by Defense Secretary Brown, the key sentence is, "Defense will support the transfer of critical technology to countries with which the U.S. has a major security interest, where such transfer can: (1) strengthen the collective security, (2) contribute to the goal of weapons standardization and interoperability, and (3) maximize the effective return on collective NATO

investment in R&D." The key phrase here is "return on collective NATO investment," not just the return on U.S. investment. This policy has been applied in a number of key transfer decisions made in the last six months.

The new policies we are undertaking are not politically motivated. Our objective is to make more effective use of NATO defense expenditures so we can increase NATO military effectiveness. We believe that effective technological cooperation can best be accomplished on a company-to-company basis. We are considering such programs in several areas, and I wish to generally encourage increased trans-Atlantic technological cooperation in the defense industries. Any proposal for technology sharing will have to pass one key test—will it increase the military effectiveness of the Alliance, and do so on an efficient Alliance basis?

Summary

While these actions display some signs of progress, there is much more to be done. I have issued a call to quarters to emphasize my personal concern for the challenge presented by the sustained program of Soviet power building.

The Alliance has responded to this challenge with a Long Term Defense Program. This program provides the means to increase defense expenditures at a rate which could roughly balance Alliance defense expenditures with those of the Warsaw Pact.

Within this framework are a number of approaches to increasing the effectiveness of our expenditures by cooperating on an Alliance basis. The innovative package approach provides a mechanism for cooperation on a true partnership basis, allowing the Alliance to develop standardized equipment, benefit from comparative advantages, and operate on a true two-way street.

New directions in Alliance cooperation will not be achieved on a business-as-usual basis. There is no way we can overcome the obstacles I described by proceeding in the future as we have in the past. But I think it can be achieved, and I am committed to giving my best efforts to make it happen.

President Carter and Defense Secretary Brown have made a personal commitment to improving the effectiveness of the Alliance. The U.S. Congress will be watching the response. I call on each of you to move in the new direction of increased Alliance cooperation—cooperation that is essential to sustaining this vital Alliance into a coming fourth decade. ‖

actual number of problems has not always been reliably recorded. The numbers

Announcement of 8TH ANNUAL DOD ACQUISITION RESEARCH SYMPOSIUM and CALL FOR PAPERS

74

The 8th Annual DOD Acquisition Research Symposium, jointly sponsored by the Defense Systems Management College (DSMC) and the Federal Acquisition Institute (FAI), will be held 2 – 4 May 1979 at the Naval War College, Newport, Rhode Island.

The symposium has a twofold purpose. The first purpose is to develop candid, open discussions between government and industry regarding major policy issues of concern to those doing business with the government. Secondly, the symposium will provide a forum for the disclosure of research accomplished in the acquisition management field. The symposium will primarily consist of workshops on the following issues:

- DOD Sponsored:

  Acquisition Decision Process; Length and Impact
  A-109 Impact on New Development and Leveling Effect
  Multi Year Authorization Need? Possibility? Impact?
  Four Step Procurement
  Realistic Cost Estimating
  Missionized RFP
  Concurrency
  Design to Affordability
  Acquisition Process Credibility

- FAI Sponsored:

  Civil Agency Contracting Officer Role
  Socio-Economic Programs Impact
  Commercial Product Specifications

CALL FOR PAPERS: You are invited to participate in the resolution of pertinent issues by providing the results of your research, personal expertise or ideas to the symposium in the form of a paper dealing with one (preferably), or more of the above issues, or a closely related matter. Papers judged to add substantially to the understanding or possible resolution of an issue will be referred to the symposium panelists for consideration prior to the workshop session at the symposium. These papers will also be considered for publication in the *Defense Systems Management Review*. Special recognition for the most meaningful papers will be given.

Abstracts (200–500 words) are required and should be sent to the Defense Systems Management College, ATTN: Program Chairman (Lt Col Robert Machen), Fort Belvoir, Virginia 22060, not later than 19 January 1979. Abstracts will be reviewed

for appropriateness and each researcher will be notified of acceptance or non-acceptance by 1 February 1979. Detailed instructions for preparation of the final (20 page limit) paper will be provided with notification of acceptance.

Final papers must be received by the program chairman not later than 6 April 1979 in order to be eligible for special recognition at the symposium. Researchers who submit acceptable papers will be invited to attend the symposium and the appropriate workshop sessions.

SUMMARY SCHEDULE

19 January 1979 – Abstract receipt deadline

1 February 1979 – Acceptance notification deadline

6 April 1979 – Final paper receipt deadline

2 May 1979 – Symposium starts